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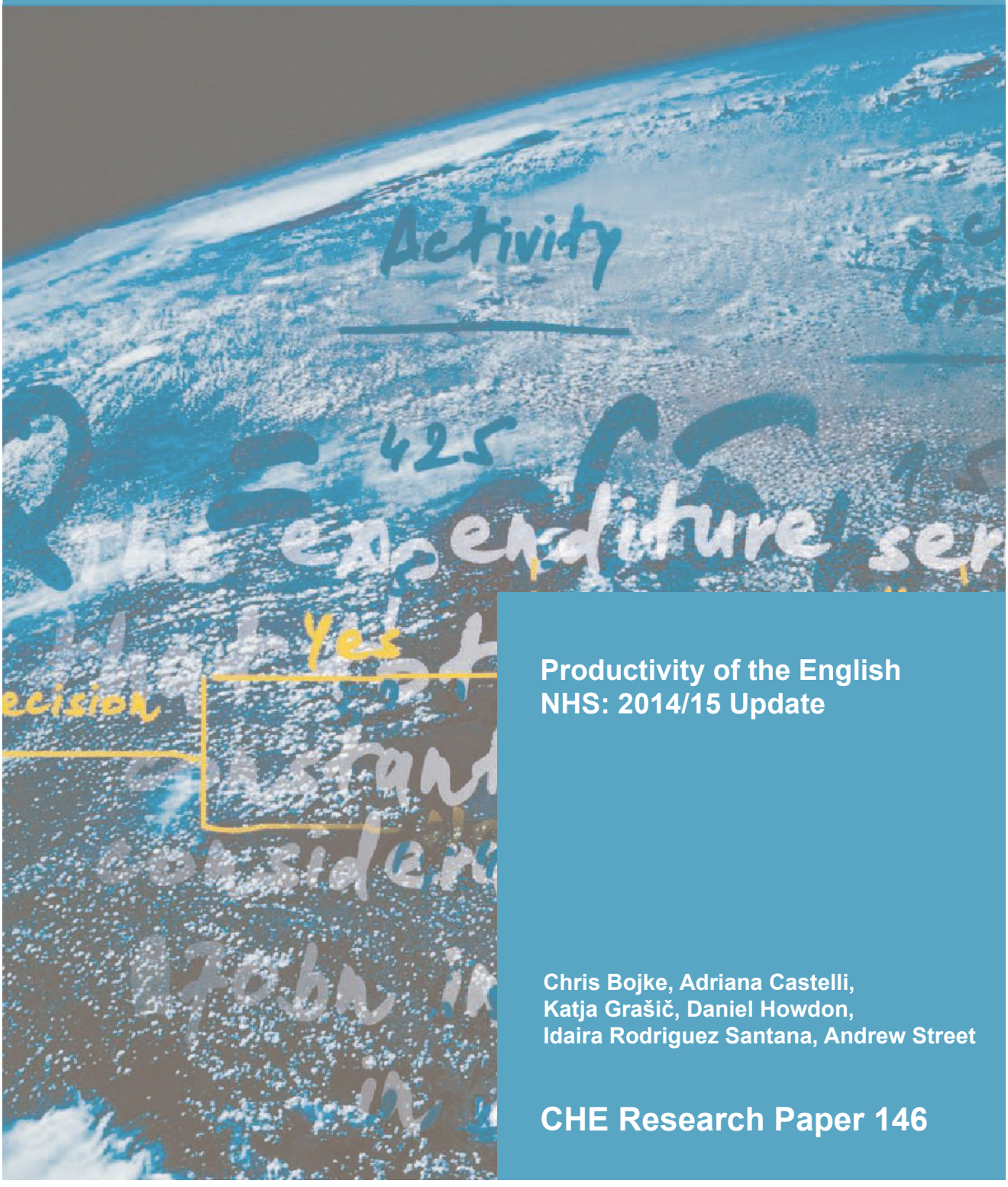

Productivity of the English NHS: 2014/15 Update

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CHE Research Paper 146

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Chris Bojke
Adriana Castelli
Katja Grašič
Daniel Howdon
Idaira Rodriguez Santana
Andrew Street

Centre for Health Economics, University of York, York, UK

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Correction

An earlier published version of this report was subsequently found to contain an error in the calculation of primary care output growth. This error has now been corrected and the primary care figures, and those to which they contribute, have been revised.

Acknowledgements

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No Ethical approval was needed as we use Secondary data.

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Centre for Health Economics
Alcuin College
University of York
York, UK
www.york.ac.uk/che

Executive summary

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, but this report updates the series to account for growth between 2013/14 and 2014/15, as well as looking at 10 year growth trends since 2004/05.

NHS productivity is measured by comparing growth in the outputs produced by the NHS to growth in the inputs used to produce them. NHS outputs include the amount and quality of care provided to patients. Inputs include the number of doctors, nurses and support staff providing care, the equipment and clinical supplies used, and the hospitals and other premises where care is provided.

The measure of NHS output captures all the activities undertaken for all NHS patients wherever they are treated in England. NHS output has increased between 2004/05 and 2014/15 primarily because ever more patients are receiving treatment. Compared to 2004/05, hospitals are treating 4.6 million (27%) more patients, while the number of outpatient attendances has increased by 19%.

The output measure also accounts for changes in quality. On the upside, there have been year-on-year improvements in hospital survival rates. On the downside, waiting times have been getting longer since 2009/10, although they remain shorter than they were in 2004/05. Taking account of the amount and quality of care, overall NHS output increased by 51% between 2004/05 and 2014/15. Output growth between 2013/14 and 2014/15 amounted to 2.49%.

Increased NHS output has come about in response to pronounced increases in NHS expenditure. This has funded both higher wages and more staff and resources. Wages rose by 19% between 2004/05 and 2014/15, while there was a 10% increase in the number of NHS staff. There has been increased use of agency staff, but there have been periods of retrenchment, notably whenever the hospital sector has been struggling to reduce deficits.

Between 2004/05 and 2014/15 the use of materials and capital increased respectively by 111% and 105%. Altogether NHS inputs have increased by 46% since 2004/05, with input growth between 2013/14 and 2014/15 amounting to 1.94%.

We calculate productivity growth by comparing output growth with input growth. Over the last decade NHS productivity has increased by 13.63% in total. Productivity growth has been especially strong since 2009/10, year-on-year growth averaging 1.37%. Growth between 2013/14 and 2014/15, as these latest figures show, amounted to 0.53%.

This rate of NHS productivity growth since 2004/05 compares favourably with that achieved by the economy as a whole. Annual NHS productivity growth kept pace with that of the economy up to the recession in 2008/09. Since then NHS productivity growth has consistently outpaced that of the economy, which has stagnated.

Glossary of acronyms

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

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 2013/14 and 2014/15, as well as looking at 10 year growth trends dating 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 2013/14 and 2014/15. This latest 'link' is then attached to the chained index that reports productivity changes over the last decade.

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

Growth in the volume of inputs is calculated primarily using expenditure data. Current spending on labour, capital and material resources are deflated to the previous year's costs in order to 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 2013/14 and 2014/15. Specific details are provided about any potential data collection and coding artefacts that may compromise a genuine like-for-like comparison across the two years.

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

2 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.[1] 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 2013/14 – 2014/15. 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 2013/14 and 2014/15 data
Elective	HES	RC	30-day/in- hospital survival; health outcomes; waiting times	Activity described by HRG4+ In-hospital survival is used for years 2013/14 and 2014/15
Non-elective	HES	RC	30-day /in-hospital survival; health outcomes	Activity described by HRG4+ In-hospital survival is used for years 2013/14 and 2014/15
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+ In-hospital survival is used for years 2013/14 and 2014/15
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 services	NHS Digital	NHS Digital	N/A	

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

[1] 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.[2] HES comprises of almost 19.5m records for 2013/14 and 20.2m in 2014/15. We convert HES records, defined as Finished Consultant Episodes (FCEs), into Continuous Inpatient Spells (CIPS) using the official algorithm for calculating CIPS published by NHS Digital (formerly the Health and Social Care Information Centre).[3] We then count the number of CIPS in each Healthcare Resource Group (HRG), which form the basic means of describing different types of hospital output.

The cost of each CIPS is calculated on the basis of the most expensive FCE within the CIPS, with costs for each HRG derived from the Reference Cost data (Bojke et al., 2013), our previous research suggesting that results are not sensitive to the alternatives of calculating the costs of CIPS on the basis of the first episode or the sum of all episodes (Daidone and Street, 2011). Reference Costs are reported for each HRG according to their point of delivery, indicating whether the patient was treated as 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 daycase 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.

There was a big overhaul of the HRG grouping system between 2013/14 and 2014/15. The number of HRGs increased from 2,289 in 2013/14 to 2,782 in 2014/15; however, only a third of HRGs are common between the two years. We observe 1,102 new HRGs in 2014/15 that were not existing in the previous year; further, 609 HRGs were discontinued and 51 HRGs changed their definition between the two years.

Changes to the HRG system pose some difficulties in constructing the output index because costs might not be available for some activities. In such cases we deflate current costs in order to impute prior values (Castelli et al., 2011).

The vast majority of activity captured in HES is performed by hospital Trusts. As shown in Table 2, 97.5% of all activity was performed in Trusts in 2013/14 and 97.3% in 2014/15. The proportion of activity performed by private providers is gradually increasing: in 2012/13 they provided 2.1% of all activity, increasing to 2.4% in 2013/14 and to 2.6% in 2014/15.

Table 2: Organisational coverage of HES activity, FCEs

Year	NHS Trusts	Private providers	Other[4]	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

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

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 50% over the full decade, from 6.4m to 9.7m CIPs, while non-elective activity has increased by 23%, from 6m to 7.4m CIPs. While elective activity has grown steadily, growth in non-elective activity shows a more erratic pattern, as can be also observed in Figure 1. Between 2013/14 and 2014/15 the number of elective CIPS increased by 314,587 (3.4%), while non-elective activity increased by 301,512 (4.2%).

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

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.

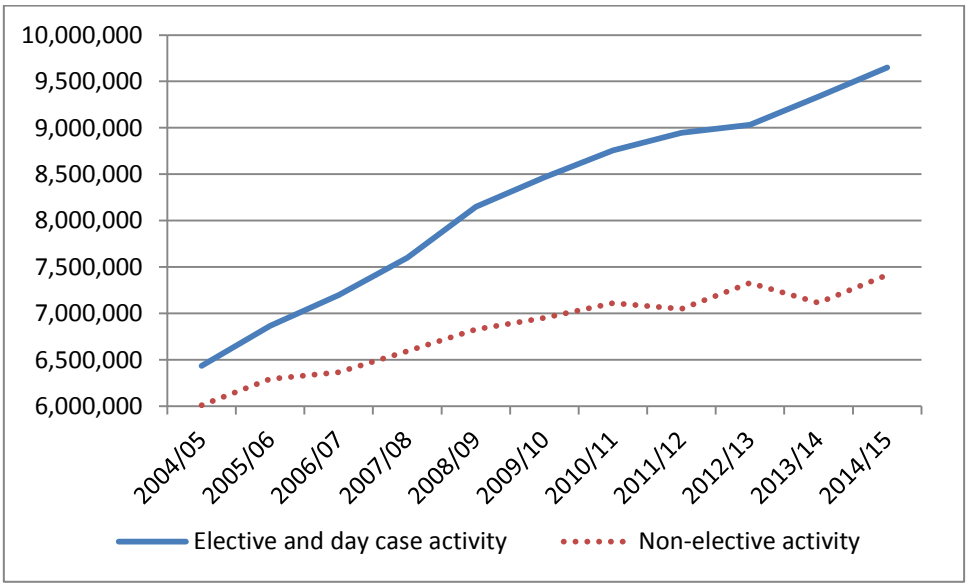


Figure 1: Changes in elective and day case and non-elective activity

After cost-weighting this activity, we observe 3.70% growth in activity for electives and day cases and a small growth of 0.6% for non-elective activity between 2013/14 and 2014/15. Combining both series, the total cost-weighted activity growth amounts to 1.94%.

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

Our measure of hospital output captures growth in both the volume of activity and improvements in quality. The quality of hospital activity is measured by survival rate, estimated change in health outcomes following hospital treatment and mean life expectancy. Up to the financial year 2013/14, we used 30-day post discharge survival rate, but we have since switched to the in-hospital survival measure because ONS date of death data were not released to us.[5] 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.[6] Table 4 and Figure 1 -3 present average values for each of these measures over time.

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

Year	Elective and day case activity				Non-elective activity		
	30-day survival rate	In-hospital survival rate	Mean life expectancy	80th percentile waiting times	30-day survival rate	In-hospital survival rate	Mean life expectancy
2004/05	99.38%		23.7	104	95.16%		34.1
2005/06	99.47%		23.7	95	95.49%		34.3
2006/07	99.51%		23.6	89	95.65%		34.6
2007/08	99.72%		23.5	74	95.79%		34.7
2008/09	99.74%		23.2	60	95.85%		34.4
2009/10	99.76%		23.4	65	96.07%		34.6
2010/11	99.78%		23.4	76	96.05%		34.8
2011/12	99.45%		23.2	85	96.62%		34.6
2012/13	99.50%	98.76%	23.2	82[a]	96.45%	97.77%	34.1
2013/14[a]	99.44%	99.93%	23.2	81	96.32%	97.27%	34.0
2014/15	-	99.93%	22.9	79	-	97.18%	33.4

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

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

[5] For the years 2012/13 and 2013/14 we have both the 30-days post discharge and in-hospital survival data, allowing us to assess the sensitivity of results to the choice of measure. First, the correlation between the two measures is high (0.99); second, total Laspeyres output growth of HES activity from 2012/13 to 2013/14 amounts to 1.73% if using in-hospital survival rates and 1.81% if using 30-day survival rates, a difference of 0.08%.

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

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 this ratio to assess the impact that treatments have on patients' health status over time.

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	0.80	0.36	0.41	0.82
2011/12	0.80	0.40	0.40	0.71
2012/13	0.76	0.36	0.37	0.80
2013/14	0.84	0.37	0.39	0.80
2014/15	0.82	0.37	0.44	0.85

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

There is little variation in mean life expectancy for those treated in hospital over the entire period, as shown in Figure 2. A slight negative trend can be observed in recent years: this is mostly likely due to increases in the average age of people admitted to hospital, rather than lower quality of care.

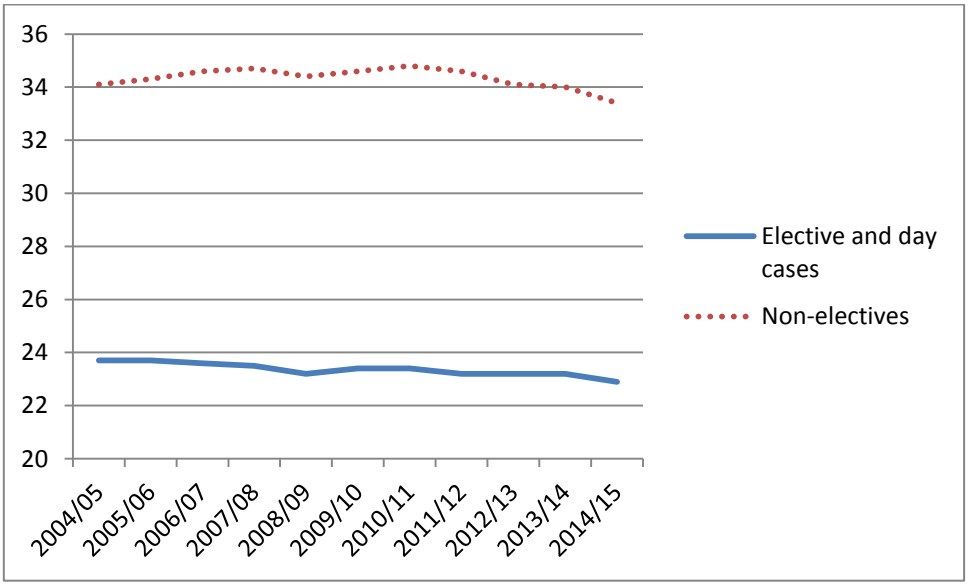


Figure 2: Mean life expectancy

Waiting times decreased in 2014/15 compared to 2013/14, as shown in Figure 3. Despite this recent improvement, waiting times remain much higher than they were in 2008/09, when they were at an historic low.

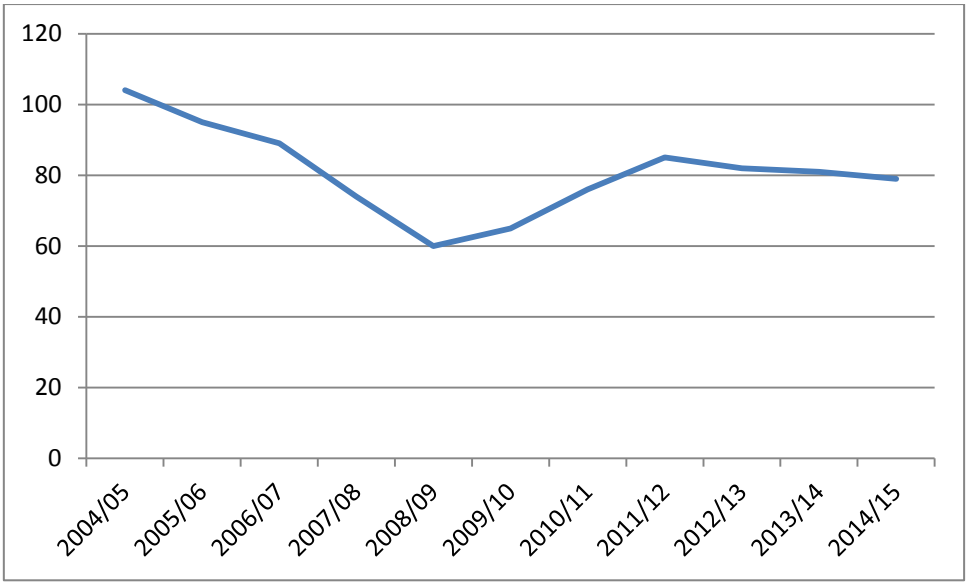


Figure 3: 80th percentile waiting times

We calculate the quality adjustment for each specific HRG, and separately for electives and non-electives. The quality adjustment is therefore also influenced by a shift of activity towards more complicated cases. **Once we take quality adjustment into account, the total Laspeyres output growth of HES activity from 2013/14 to 2014/15 decreases from 1.94% to 1.83%.**

2.2.3 Inpatient mental health

We identify 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). As seen in Table 6 and Figure 4, there has been year-on-year variation over the last decade in the number of patients with mental health problems treated in an elective/ day case setting and a non-elective setting, but numbers have decreased over the last three years.

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

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

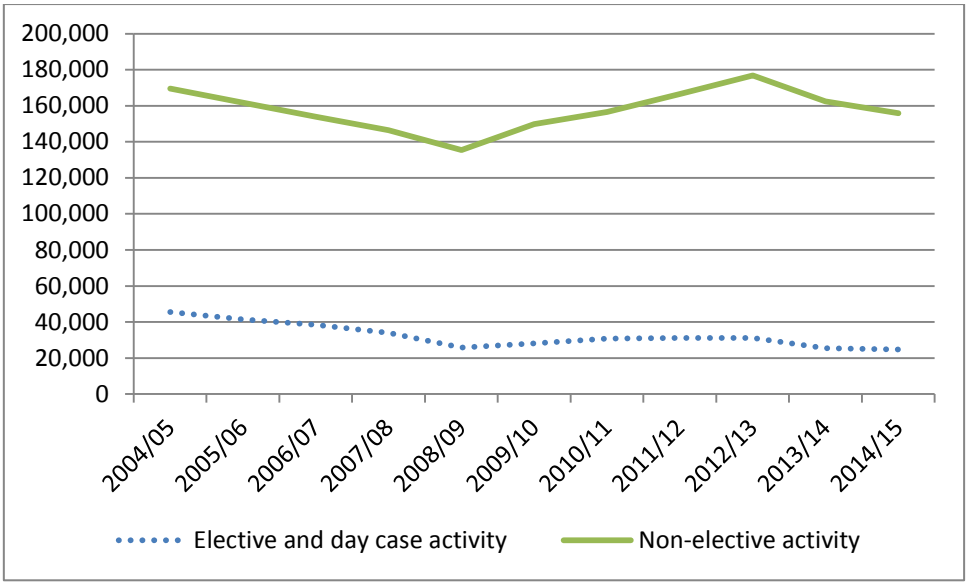


Figure 4: Number of CIPS for elective, day case and non-elective mental health patients over time

After cost-weighting mental health activity, we observe a decline of -4.11% between 2013/14 and 2014/15.

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		99.10%	31.3	51		98.25%	27.1

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

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). **Once we take quality adjustment into account, output growth from 2013/14 to 2014/15 changes from -4.11% to -4.42%.**

2.2.5 HES outpatient activity

The volume of outpatient activity can be derived from both the HES Outpatients Dataset and RC data, but we always use RC to determine costs. A like-for-like comparison between the two datasets is not wholly possible because the activity data are recorded somewhat differently in each. Specifically, this is because it is not possible to classify HES 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.

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

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

Table 8: Volume and average cost over time

Year	All providers (excl. ISHP and 'Other providers')		Trusts only	
	Volume	Average cost (£)	Volume	Average cost (£)
2011/12	88,926,968	114.00	87,589,260	114.30
2012/13	90,850,009	116.98	90,126,813	117.19
2013/14	96,690,559	117.18	96,689,126	117.18
2014/15	101,382,540	118.26	101,382,540	118.26

Table 8 shows the volume of attended activity and average cost of activity for all providers, excluding Independent Sector Healthcare Providers (ISHP) and other providers. Only hospital Trusts were included in order to make the series consistent with the previously reported series constructed using Reference Cost data. **After cost weighting the activity, the Laspeyres growth index is 3.52%.**

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 was 57 days in 2013/14, rising to 61 days in 2014/15. Accounting for this has virtually no impact on the growth index which drops to **3.51%.**

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

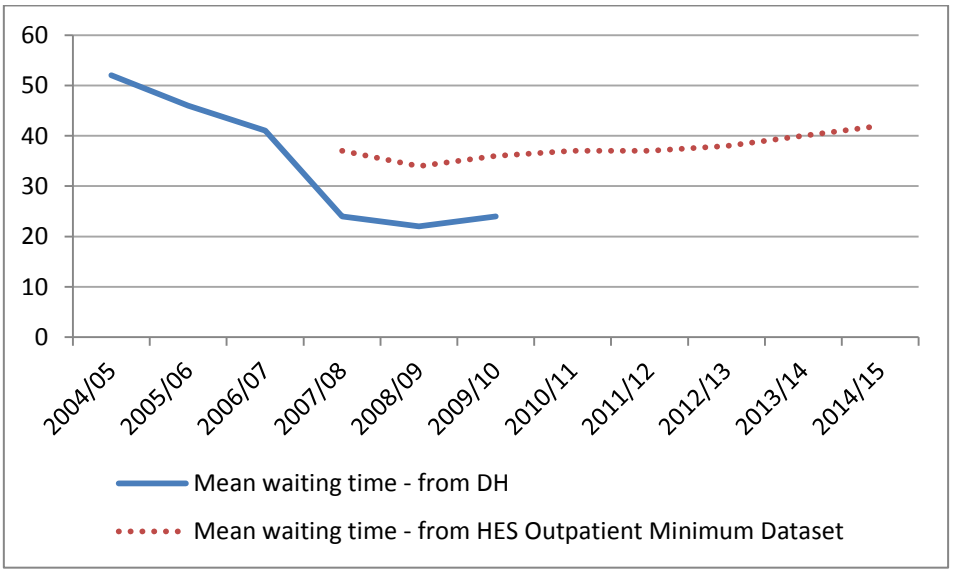


Figure 5: Trends in outpatient waiting times

2.3 Reference cost data

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

In 2012/13 and 2013/14, the RC returns only covered activity undertaken by hospital Trusts, but in 2014/15 RC returns were also submitted for contracted-out activity, that is activity delivered by independent sector (non-NHS) providers. This activity is, however, not included in this report because only a single year's worth of data is available.

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).

There are two major issues that need to be considered when using the Reference Costs data for our purposes:

1. The accuracy of the reported data
2. 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. DH checks of the quality of Reference Cost returns are of the following nature:

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

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

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

Over and above these checks, we have implemented our own validation process (Bojke et al., 2014). This focuses on identifying large increases/decreases in either volume or unit costs of activity for all non-acute services. In particular, we check 1) whether volumes of activity have registered either an increase or decrease of more than 500,000 units or 2) whether the value of activity has registered an increase or decrease of more than £25 million.

In the event that large scale changes are detected, we look at each activity in isolation to determine the most appropriate solution. These may be: to leave as is, replace an unexpected high cost value with the minimum cost across the two years, or omit the category from the output index. Our validation checks performed with the RC 2014/15 data show only one incongruity for 4 Renal Dialysis HRGs. See Table 10 for details.

We believe that a coding error occurred for HRGs LD05B and LD06A, as the figures for both Volume of activity and Number of Data submissions (i.e. submissions by Trusts) in 2013/14 and 2014/15 appear to be switched around. In addition, the figures for Volume of activity and Number of Data submission for HRG LD04A in 2014/15 are very similar to those for HRG LD05A in 2013/14, as reported in Table 10.

After correcting these apparent mistakes, we have decided to keep in our measure of output growth the HRGs LD05A, LD05B and LD06A for the financial year 2013/14 and the HRGs LD04A (which we have mapped with HRG LD05A for 2013/14), LD05B and LD06A for the financial year 2014/15. We have dropped only one HRG in each financial year: LD04A in 2013/14 and LD05A in 2014/15. The total volume of activity that has been excluded is 20,269 for HRG LD04A in 2013/14 and 83 for HRG LD05A in 2014/15. See Table 11 for mapping of HRGs.

Table 10: Coding issues for renal dialysis HRGs

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

Table 11: Mapping of renal dialysis HRGs

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

Table 12 summarises the RC data according to broad service settings over the past three years. This shows that the number of categories is quite stable between 2013/14 and 2014/15 across the different settings, the exception being Radiology where the number of categories has almost doubled from 136 to 258 (although there were 5,047 in the 2012/13 collection).

Despite changes in how activities are described, we are able to accommodate these in the measurement of output growth using RC data (Castelli et al., 2011). This is because, although category descriptions differ, the old and new categories are generally capturing the same types of activity.

Table 12: Reference cost settings

Setting	2012/13			2013/14			2014/15		
	Nr Cat.	Activity	Cost (£)	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	89	36,551,479	4,201,423,614
Chemo/Radiotherapy & High Cost Drugs	317	6,754,603	2,652,051,626	323	6,988,301	2,915,174,231	344	7,567,487	3,351,048,218
Community Care	149	79,709,044	4,139,765,181	174	85,975,592	4,864,684,367	180	85,733,534	5,052,768,659
Diagnostic Tests	64	342,280,609	941,490,357	72	368,505,992	964,981,062	82	363,656,649	994,023,634
Community Mental Health	117	260,266,214	6,311,927,307	124	259,659,214	6,410,525,825	129	262,460,243	6,489,460,422
Outpatient	6,979	77,222,725	8,546,218,360	8,055	81,699,802	9,275,173,143	9,465	83,856,229	9,815,241,661
Radiology	5,047	9,381,616	859,058,674	136	9,709,456	904,796,391	258	9,866,952	944,288,512
Rehabilitation	119	2,715,650	817,792,033	113	3,002,512	893,588,640	121	3,008,889	954,413,054
Renal Dialysis	40	4,135,914	528,076,698	40	4,079,238	533,459,915	39	4,070,447	533,927,599
Specialist Services	86	4,359,263	2,927,444,066	145	4,699,893	3,030,502,560	145	4,967,499	3,252,277,420
Other	3,099	4,763,955	354,760,843	937	3,927,412	309,107,379	1,119	3,407,664	287,913,867

2.3.2 RC outpatient activity

Outpatient activity as measured in the RC database has tended to be classified into three major groups: consultant led activity; non-consultant led activity; and procedures. Consultant and non-consultant led activity represent broadly the same set of outpatient specific HRG-style codes (currency codes beginning with WF) and outpatient procedure codes represent procedure related HRGs which may appear in other hospital settings (for example in 2013/14 Reference costs, HRG AA21G [minor intracranial procedures] occurred 1,648 times as a hospital day case and 3,662 times as an outpatient procedure). On average, consultant led activity for Trusts represents over 71% of overall outpatient cost-weighted activity. Outpatient procedures have increased considerably in volume: representing just 3% of overall outpatient activity in 2007/08 and nearly 13% in 2014/15.

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

The Laspeyres output growth measure for outpatient activity as captured by the Reference Costs data was 3.71% from 2013/14 to 2014/15, which compares to 3.52% when using the HES outpatients data.

The difference between HES and RC measures of growth is very small, with RC reporting 0.19% higher growth. 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 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.[7] Between 2013/14 and 2014/15 there was an increase (of almost 2%) in the total number of emergency department attendances, but there was a 4% reduction in the number of people being admitted to hospital.

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

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 6.9% between 2013/14 and 2014/15, but there was a 9.7% reduction in the number of these subsequently being admitted to hospital. Overall, the total volume of A&E activity increased by 3.1% between 2013/14 and 2014/15.

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

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

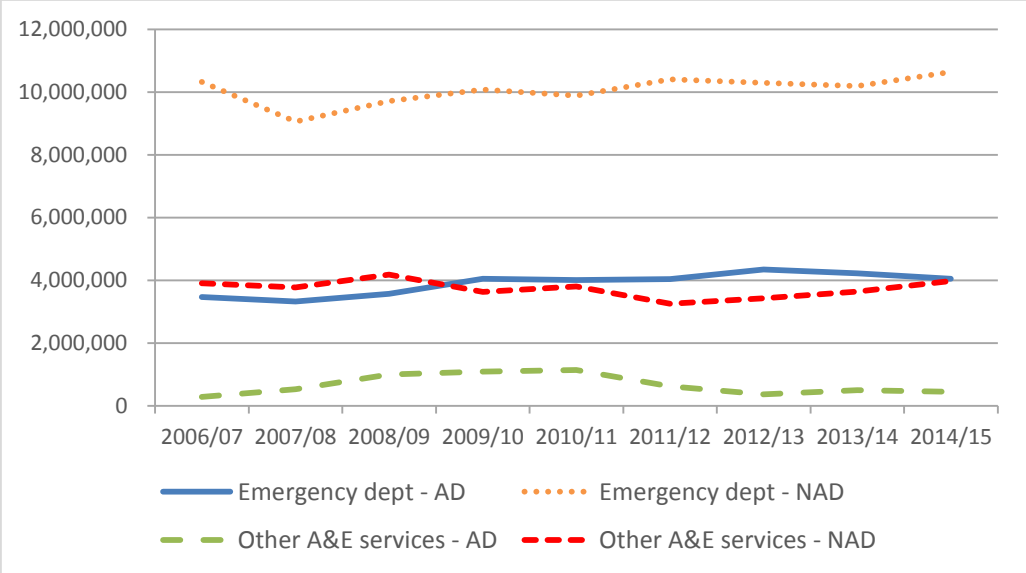


Figure 6: trend of A&E activity across settings

Ambulance services are reported in Table 15 for the four years since this activity was first recorded in the Reference Cost database. Activity is measured in terms of calls received for the category 'Calls'; patients for the category 'Hear and treat or refer'; incidents for the categories 'See and treat or refer' and categories 'See and treat and convey'. Overall activity by ambulance services increased between 2013/14 and 2014/15, with the category 'Hear' alone increasing by 43.8%, and the category 'See and treat and convey' increasing by just 0.8%.

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

The Laspeyres output growth measure for the setting 'A&E services', which includes ambulance services, increased by 4.17% between 2013/14 and 2014/15.

2.3.4 Chemotherapy, Radiotherapy & High Cost Drugs

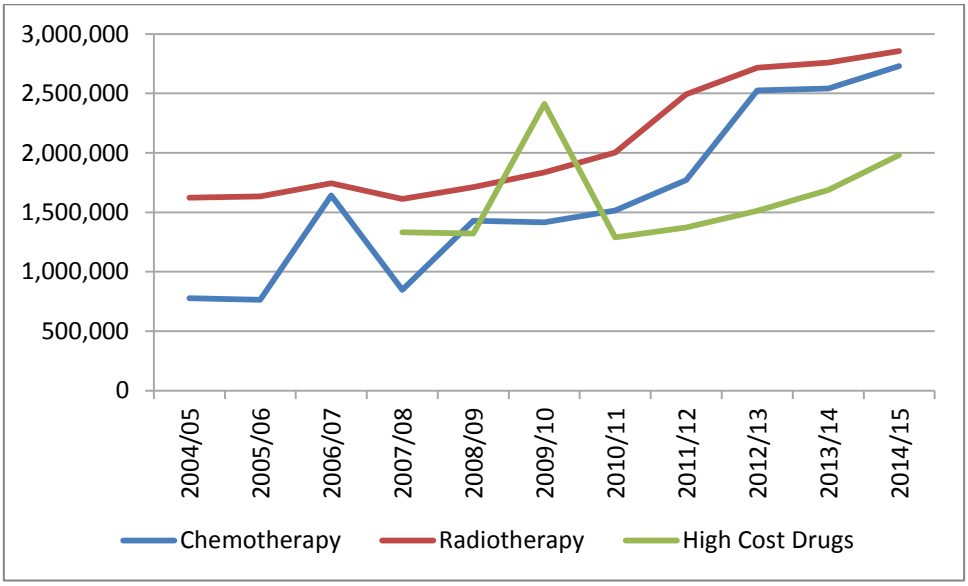
The categories used to describe Chemotherapy, Radiotherapy, and High Cost Drugs have been subject to substantial revision over time, making it difficult to infer much from the simple counts of activity reported below in Table 16 and Figure 7. Between 2013/14 and 2014/15, however, categorisation has been fairly stable, with only High Cost Drugs experiencing an increase in the total number of categories (20 new groups were introduced in 2014/15). Radiotherapy had one new category added in 2014/15 and one dropped, whilst Chemotherapy had no categorisation changes. The total volume of Chemotherapy activity increased by 7.5%, that of Radiotherapy by 3.4% and that of High Cost Drugs by 17.9% (some of this increase might be due to new categories capturing previously unrecorded activity, though this cannot be determined).

The Laspeyres output growth measure for Chemotherapy, Radiotherapy & High Cost Drugs was 16.34% between 2013/14 and 2014/15.

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

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 2014/15. While the provision of community care has decreased since 2009/10, this is primarily due to Primary Care Trusts (and Personal Medical Services pilots) no longer reporting this activity after 2010/11. Community care activity decreased slightly in 2014/15 (0.3%).

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

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.

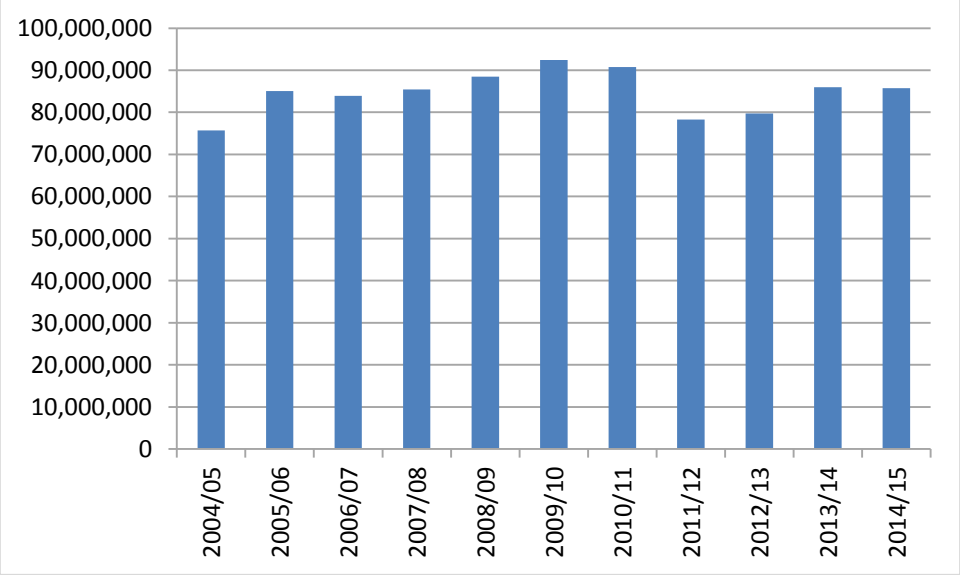


Figure 8: Trend in community care activity

In 2013/14 three new types of activities were introduced: Community Intermediate care activity, Wheelchair services and Other Therapists. As a consequence for the calculation of the Output growth index between 2012/13 and 2013/14, we omitted the three new types of activity. Further, Community Intermediate care activity included activity previously recorded as Hospital at Home and Early Discharge Scheme and Community Rehabilitation teams, so the latter were also dropped from the financial year 2012/13. In 2014/15 all the above activities have been recorded in a consistent fashion to the data in 2013/14, so it has now been possible to include this information in our measure of NHS output growth.

The Laspeyres output growth index for Community Care activity between 2013/14 and 2014/15 is 0.22%.

2.3.6 Diagnostic tests, pathology and radiology

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

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.

In 2013/14, the number of distinct categories in Radiology fell from 5,047 categories to just 136. Further inspection revealed this to be a result of a decrease in the granulation of measurement. In 2014/15, a further minor change was introduced for Radiology activity in that the coding for all its activity was changed from RA*** codes to RD*** codes, but with the same description of activity recorded. However, a substantial re-categorisation occurred for Nuclear Medicine, which in 2013/14 comprised only of 7 categories, but now has increased its granularity, bringing the total number of categories to 137.

The total volume of Directly Accessed Diagnostics services and Radiology increased by 8.8% and 1.6%, respectively between 2013/14 and 2014/15. Directly Accessed Pathology services decreased by 1.55 over the same time period. **The Laspeyres output growth for each broad type of test was 7.62%, -2.39% and 2.62% respectively, leading to an overall growth for these combined activities of 1.13%.**

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 20 provides a more detailed breakdown of Community Mental Health activity since the clusters were first employed.

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

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.

Table 20: Care clusters and other mental health activity

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**

In terms of raw activity, Community Mental Health increased by 1.1% from 2013/14 to 2014/15, but there was a shift toward more costly activities **with cost-weighted output growth amounting to 3.03%.**

2.3.8 Rehabilitation and renal dialysis

Table 21: 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

The volume of rehabilitation and renal dialysis activity over time is reported in Table 21. The total volume of Rehabilitation services increased by 0.2% between 2013/14 and 2014/15, and the total volume of Renal Dialysis remained virtually unchanged. **The Laspeyres output growth for Rehabilitation and Renal Dialysis services were, respectively, 2.35% and 2.43% between 2013/14 and 2014/15.**

2.3.9 Specialist services

The volume and cost of various types of specialist services are reported in Table 22.

Table 22: 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

The total volume of Adult Critical Care services increased by 1.4%, that of Specialist Palliative care by 10.6%, that of Cystic Fibrosis by 7.8% and that of Cancer Multi-Disciplinary Team Meetings activity by 12.1% between 2013/14 and 2014/15.

Taken together, the Laspeyres output growth measure for Specialist Services increased by 0.61% between 2013/14 and 2014/15.

2.3.10 Other Reference Cost activities

Other types of activity reported in the Reference Costs are summarised in Table 23. The way of classifying these activities has changed somewhat over time, so rarely are the series recorded in a consistent fashion across all years. Recording of some types of activity is occasionally discontinued, or subsumed under other broad categories.

Table 23: 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	-	-

Regular Day and Night Admissions (RDNA) activity has seen some change in the coding, with about 53% of 2014/15 activity already being recorded in 2013/14. There has been no change in coding for both Audiological Services and Day Care Facilities. The total volume of RDNA activity increased by 9%, whilst that of patients treated in Day Care Facilities increased by 11.4% between 2013/14 and 2014/15. The total volume of Audiological Services decreased by 16.2% between 2013/14 and 2014/15. Hospital at Home services are now captured under Community Intermediate Care activities in the community care setting.

The Cost-weighted output growth measure for 'Other NHS activity' increased by 1.45% between 2013/14 and 2014/15.

2.3.11 Total Reference Cost growth

Including outpatient data, the activities recorded in the Reference Cost returns grew by 3.64% from 2013/14 to 2014/15. The growth was mainly a result of the larger categories (A&E and Mental Health) growing at around 3% or more, and with Chemotherapy, Radiotherapy and High Cost Drugs growing at 16.34%. **Excluding Outpatient activity, the data contained in the Reference Cost returns suggest that output grew by 3.61% from 2013/14 and 2014/15.**

2.4 Dentistry and ophthalmology

Information about dentistry is derived from the NHS Digital website[8] with dental activity differentiated into dental bands, as shown in Table 24.

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

Table 24: Dental services

Year	Dentistry										
	Band 1		Band 2		Band 3		Urgent		Other		Total
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average 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

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

As shown in Figure 9, dental output went down in Bands 2 and 3, and for Urgent and 'Other' dental care in the financial year 2014/15 compared to 2013/14. Overall, the value of dental activity decreased between the two years as shown by its Laspeyres growth rate, which is -1.6% for this period.

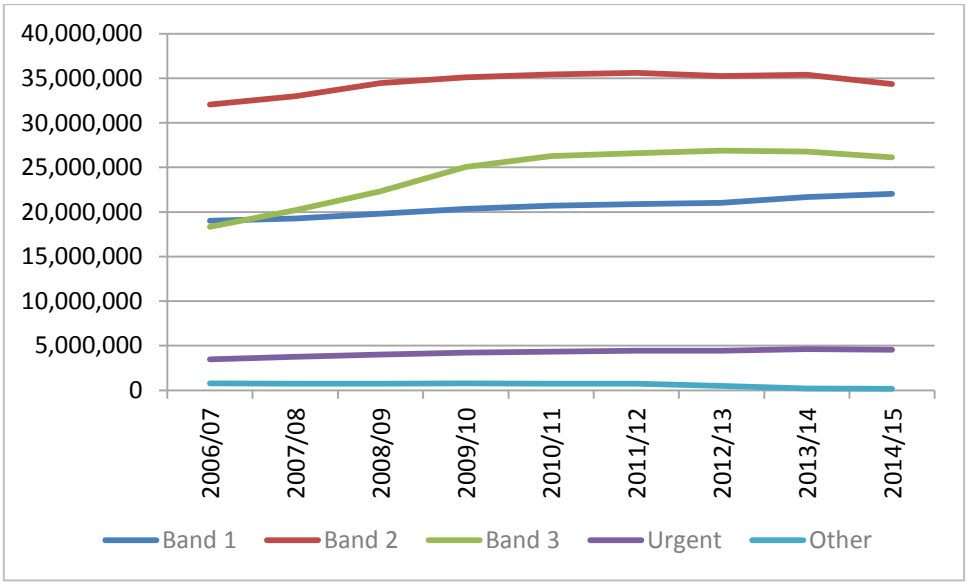


Figure 9: Number of courses of treatments (CoT) over time

Data about the volume of activity for ophthalmology is published by NHS Digital on a bi-annual basis.[9] Table 25 presents the volume of activity and cost for ophthalmic services over time.

Table 25: Volume and average cost in ophthalmology

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

There was a very small decrease in ophthalmic activity between the financial years 2013/14 and 2014/15, with cost-weighted output growth equal to -0.2%.

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

2.5 Primary care activity[10]

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

Table 26: CHE primary care evidence sources

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

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

From 2008/09, CHE's source of primary care data switched to survey based measures: initially the General Lifestyle Survey (GLS), but from 2010/2011 onwards, the GP Patient Survey (GPPS). Although the switch was forced by the lack of access to QResearch, there is some benefit in basing activity estimates on a sample which is weighted to be representative of the general population, rather than having a sample which is merely thought to be broadly representative. There are, of course, major disadvantages of the survey approach, including a smaller sample (1.5 million patients as opposed to 9 million) but, more importantly, there is less detail in the survey data. In the GP Patient Survey, patients are asked only when they last had any contact with their GP or nurse within discrete time frames. These responses are then extrapolated to reflect a number of contacts over the course of a year. In addition, there are no data on the type of contacts and so the distribution of contacts as observed in the 2008/09 QResearch data has been assumed ever since.

Our method assumes that the estimate of consultation rate (i.e the ratio of consultations to population) for 2008/09, derived from QResearch, is reliable. We do not have access to QResearch for later years, but as is normal in construction of a Laspeyres index we estimate subsequent years by estimating the percentage change in each successive pair of years. For 2009/10, the General Lifestyle Survey suggested that there was no change in the rate of consultations. For years from then until 2013/14 we use GPPS data and look at the change in the percentage of respondents saying that they had seen their GP in the preceding 3 months. Beyond 2013/14, we additionally take account of the change in the percentage of respondents saying that they had seen or spoken to a practice nurse in the preceding 3 months (and for 2014/15 we also look at different growth rates for each age/gender group). This formulation is as follows:

$$\tilde{x}_t = \frac{p_t}{p_{t-1}} \tilde{x}_{t-1}$$

Here, $\tilde{x}_t$ is the estimated number of GP or nurse observations in year t and p_t is the proportion of individuals who have seen a GP or nurse in the last 3 months in year t. The baseline for the number of consultations is 2008/09, this being the last year in which there was a QResearch measure of the number of consultations. Since then the GLS or GPPS ratios have been applied year-by-year to obtain annual estimates of the number of consultations in each subsequent year.

[10] An earlier published version of this report was subsequently found to contain an error in the calculation of primary care output growth. This error has now been corrected and the primary care figures, and those to which they contribute, have been revised.

These annual estimates are then uplifted to adjust for population growth. Between 2009/10 and 2011/12 these adjustments were based on the UK population, from 2011/12 to 2013/14 the adjustments were based on the English population, and since 2013/14 they have been based on the English population accounting for changes in age and gender composition. We now calculate population growth δ_{ti} for each of the 5-year age/gender groups and use this to adjust the estimated number of GP and nurse observations according to the following formula:

$$\tilde{x}_{ti}\delta_{ti} = x_{ti}$$

As can be seen in Figure 10, there has been a shift in the age of population which is now older. This also implies an increase in the number of consultations, as older people tend to have more consultations in a year.

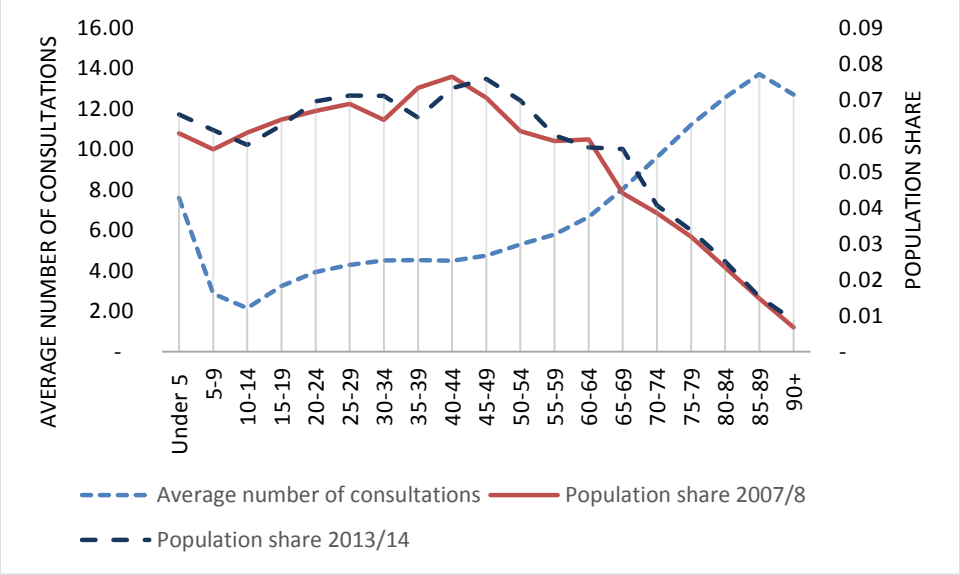


Figure 10: Population characteristics

Table 27: 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

Notes:
*The population-adjustments are based on estimates for England only, and since 2013/14 these have also been adjusted for age and gender.
** Up to 2013/14, the number of consultations was based on those reporting they'd seen a GP within the previous 3 months. For 2013/14 - 2014/15, 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). This is the baseline used in other estimates of primary care activity, reviewed in Appendix B.

The numbers of primary care consultations reported in Table 27 are those that were used to construct the year-on-year growth in primary care output as published in our successive NHS productivity reports. The figures do not, therefore, constitute a consistent historic series and should not be interpreted or used as such.

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 28 (Curtis, 2014).

Table 28: 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

We account for changes in the quality of primary care activity using the following Quality & Outcomes Framework (QOF) achievement indicators for the following conditions (Derbyshire et al., 2007):

1. Coronary heart disease (CHD002)
2. Stroke (STIA003)
3. Hypertension (HYP006)

The numbers for prevalence are obtained from Annex 1 of the QOF report.[11] Data about success rates are obtained from the Clinical results tables, available in the same report. These data are summarised in Table 29.

Table 29: Quality adjustment for primary care (%)

Year	Prevalence			QOF achievement		
	CHD	Stroke	Hypertension	CHD	Stroke	Hypertension
2004/05	3.57	1.63	10.41	78.60	73.13	64.33
2005/06	3.57	1.66	11.48	84.44	81.22	71.05
2006/07	3.54	1.61	12.49	88.86	86.92	77.62
2007/08	3.50	1.63	12.79	89.41	87.51	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	3.40	1.71	13.52	90.16	88.57	79.30
2011/12	3.38	1.74	13.63	90.14	88.61	79.65
2012/13	3.40	1.70	13.68	90.57	89.26	80.79
2013/14	3.29	1.72	13.73	91.27	89.84	83.09
2014/15	3.25	1.73	13.79	91.98	88.17	83.61

[11] http://content.digital.nhs.uk/catalogue/PUB18887

The Laspeyres growth rates for primary care are reported in Table 30.

Table 30: 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	-2.29%		-3.39%
2010/11 - 2011/12	3.51%		4.79%
2011/12 - 2012/13	1.54%	2.39%	2.45%
2012/13 - 2013/14	-1.01%	0.27%	0.37%
2013/14 - 2014/15*	-1.07%	-0.16%	-0.14%

The survey data suggest that the number of primary care consultations decreased by -1.07% between 2013/14 and 2014/15. Scaled up to account for population growth, the growth in primary care activity amounts to -0.16%. Finally, after taking account of the net, albeit small, improvements in the quality of consultations over these two years, the growth in primary care consultations amounts to -0.14%.

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.

In February 2017 NHS Digital reported omissions in prescribing data previously released for the financial years 2012/13, 2013/14 and 2014/15. These omissions are due to some changes in the data extraction process. The omitted drug items accounted for 0.2%, 0.8% of the total prescription items for the financial years 2012/13 and 2013/14 respectively.

Table 31 reports summary statistics about community prescribing. For the financial year 2013/14, we report two sets of figures: the first figure was used to construct the output and productivity growth figures for 2012/13 – 2013/14, the second to calculate the growth figures for 2013/14 – 2014/15 based on NHS Digital's revised figures. Drugs are categorised according to their chemical composition and the number of category changes throughout the years, with the peak in 2004/05 (8,779 categories), falling to a low in 2013/14 (7,809 categories). Variations in the number of categories are usually due to zero counts in some years, rather than definitional changes.

The 2014/15 data contain information on 7,926 distinct community prescribed drug items representing over a billion prescriptions with a total value/cost of approximately £8.9 billion, which is almost £240m more than in 2013/14. There are 736 new drug items totalling £13.8m that appear

in 2014/15 but not 2013/14. There are 619 drug items which appeared in 2013/14 but not in 2014/15, with a lagged total spend of £4m. There are no data items which appear obviously incorrect and we therefore take the data at face value.

Table 31: 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

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 can observe changes in average cost of prescription and in unit (i.e. item) cost over recent years (Table 31). Output and price indices for community prescribing are reported in Table 32. Prices have fallen year-on-year over the whole period, the drop is minimal between 2013/14 and 2014/15, being equal to -0.2%, a smaller decrease than that recorded in previous years.

Table 32: 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

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

The Laspeyres growth in the volume of prescriptions has increased annually, the most recent year-on-year increase amounting to 4.11%.

Taking the base year as 2004/05, trends in the volume and prices of pharmaceuticals are shown in Figure 11.

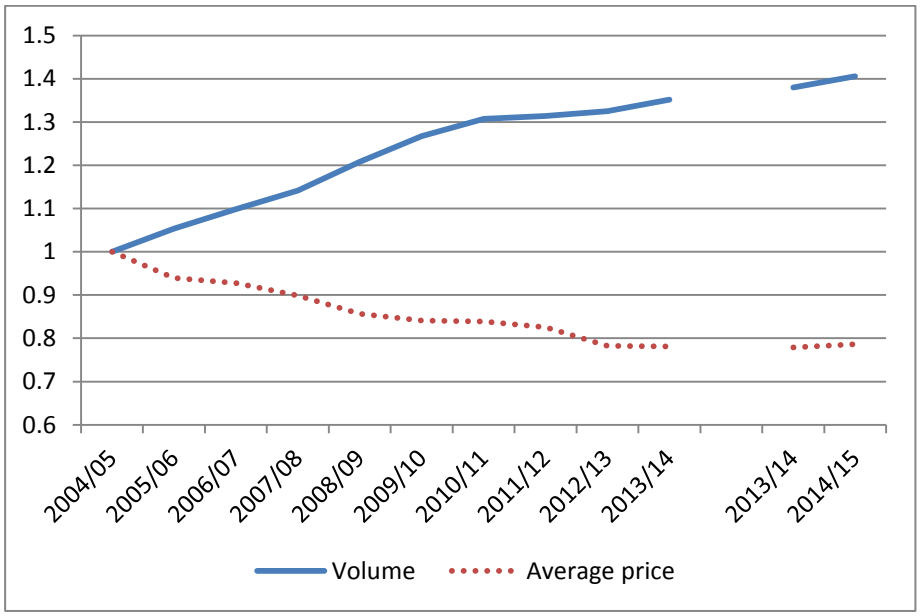


Figure 11: Price and volume changes for community prescribed pharmaceuticals

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 33 this generates our cost-weighted output growth index, which increased by 2.53% between 2013/14 and 2014/15**.

We then re-scale each type of cost-weighted output according to changes in survival, health improvements, waiting times, and blood pressure monitoring. **This generates our quality-adjusted**

index, which increased by 2.49% between 2013/14 and 2014/15. This is slightly (0.04%) lower than the cost-weighted index. This is because there were improvements in some of the quality measures and deteriorations in others, the net effect being a slight overall reduction in quality.

Table 33: 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%

2.7.1 Contribution by settings

Not all settings contribute equally to the output index. Figure 12 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 34.

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

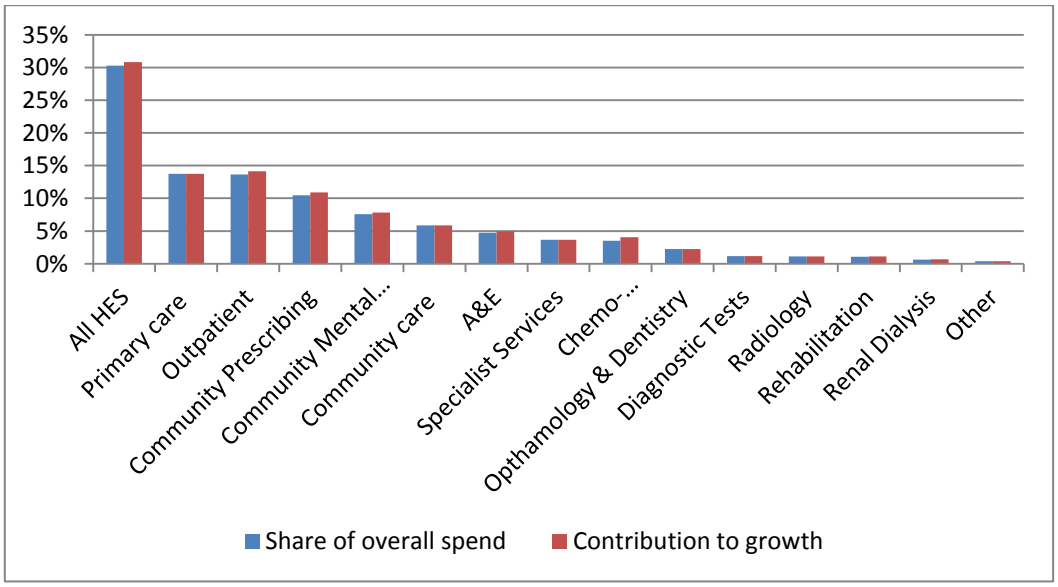


Figure 12: Contribution by setting, 2014/15

Table 34: Contribution of setting to growth, 2014/15

Setting	Setting specific growth	Value of Activity (13/14 prices) *(£)*	Share of overall spend	Contribution to growth**
All HES*	1.73%	25,171,675,790	30.28%	30.80%
Primary care*	-0.14%	11,439,141,636	13.76%	13.74%
Outpatient*	3.51%	11,330,060,302	13.63%	14.11%
Community Prescribing	4.11%	8,703,169,718	10.47%	10.90%
Community Mental Health	3.03%	6,297,089,549	7.57%	7.80%
Community care	0.22%	4,864,684,367	5.85%	5.86%
A&E	4.17%	3,923,106,579	4.72%	4.92%
Specialist Services	0.61%	3,029,501,661	3.64%	3.67%
Chemotherapy /Radiotheraphy/High Cost Drugs	16.34%	2,902,935,540	3.49%	4.06%
Ophthalmology & Dentistry	-1.33%	1,870,731,484	2.25%	2.22%
Diagnostic Tests	-0.27%	964,981,062	1.16%	1.16%
Radiology	2.62%	904,796,391	1.09%	1.12%
Rehabilitation	2.35%	893,588,640	1.07%	1.10%
Renal Dialysis	2.43%	529,893,559	0.64%	0.65%
Other	1.45%	308,704,451	0.37%	0.38%
Total value of NHS output		**83,134,060,730**		
Overall NHS output growth				**2.49%**

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

** The contribution of each setting to growth in 2014-15 is expressed as a percentage of the total output in 2013-14. Where numbers in this column are lower than numbers in the preceding column, this represents negative growth in output for that sector.

3 Inputs

Inputs into the health care system consist of:

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

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

For capital and materials we have only expenditure data, but labour data comes from two sources: expenditure data as well as staff numbers from the Electronic Staff Record (ESR). We explore the growth consequences of using these alternative data sources about 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

Up to 2006/07, we used data from the Workforce Census to count the number of staff working in the NHS. But, since 2007/08 we use the ESR data to calculate growth in labour inputs.[12] These data are obtained from the NHS iView database[13] which draws data directly from the ESR, and combined Payroll and Human Resources system for the NHS. The data contain numbers of full time equivalent (FTEs) staff and earnings for over 580 different occupational groups for all staff employed by NHS organisations.[14] 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 (formerly the HSCIC).[15]

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.[16] In our calculation we sum basic and non-basic pay to get total earnings for each particular staff group. As non-basic pay is no longer reported by FTEs, but only by headcount, we multiply that number first by an FTE/headcount ratio to get the equivalent FTE number (as advised by NHS Digital).

Gradually more and more Clinical Commissioning Groups (CCGs) have been reporting ESR data, although 10 CCGs out of 212 are still not doing so (Table 35). The inconsistent coverage over time raises some issues regarding the use of ESR as a measure of labour input. For example, whilst not all Trusts have used the ESR (e.g. Isle of Wight), it has previously been assumed that the growth in staffing observed by Trusts within the ESR is representative of that in Trusts not submitting ESR data. However, when there are new types of organisation altogether this assumption may become untenable.

[12] We excluded one organisation from the ESR data reported in 2011/12 that had not appeared in previous years.
[13] http://content.digital.nhs.uk/iview
[14] 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))
[15] http://content.digital.nhs.uk/workforce.
[16] In the past we had information on total earnings per month, without separation in basic/non-basic.

Table 35: Number of reporting entities by organisation type

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

Note: CCGs: Clinical Commissioning Groups; CSUs: Commissioning Support Units; Non-Geographic Central Staff, code AHO; PCTs: Primary Care Trusts; SHA: Strategic Health Authorities; n/a not applicable

Table 36 shows expenditure by organisational type as determined by the summed product of staff group FTEs and average earnings. It also illustrates the impact that the NHS re-organisation has had on the apparent distribution of labour expenditure over time, especially with the shift of staff from PCTs to Trusts.

Table 36: Expenditure on labour in current prices (£m)

Organisation type	2010/11 (£)	2011/12 (£)	2012/13 (£)	2013/14 (£)	2014/15 (£)
CCGs	0	0	7	434	535
CSUs	0	0	0	318	306
NHS England	0	0	1	221	205
Non-geographical staff	0	157	143	76	71
PCTs	5,822	3,742	1,329	89	1
SHA	133	114	110	0.4	0
NHS Trusts	28,809	31,761	33,753	34,510	35,820

The number of NHS staff, measured as Full Time Equivalents (FTEs), is reported in Table 37. Figure 13 shows growth in (non-medical) labour input from the base year 2007/08. Although not reported in ESR data, we include information about the numbers of GPs and practice staff for completeness, with data taken from the Workforce Census, and use expenditure data to capture growth in these types of staff.

Table 37: NHS staff numbers

	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
GPs[a]	31,021	32,855	33,384	33,730	34,043	36,085	35,243	35,319	35,871	36,294	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
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
Ambulance staff				21,149	23,084	24,489	25,056	24,908	24,566	24,757	25,381
Administration and estates staff				237,264	243,018	262,479	263,723	250,539	242,980	239,359	245,504
Health care assistants and other support staff				101,114	106,406	112,710	114,786	116,643	116,018	119,138	123,870
Nursing, midwifery and health visiting staff and learners				366,520	372,132	379,841	380,114	377,948	363,781	366,246	372,060
Scientific, therapeutic and technical staff and healthcare scientists				141,754	150,056	159,538	165,454	168,750	164,312	165,683	173,536
Unknown and Non-funded staff				4,327	3,595	3,462	3,351	3,055	2,652	2,423	0
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								
Volume Index FTE		3.60%	-0.76%	-0.37%	2.85%	4.39%	1.91%	-0.43%	-2.11%	0.72%	2.27%
Labour Index		3.44%	0.64%	0.64%	4.22%	4.55%	1.29%	-0.24%	-1.95%	0.38%	2.80%

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

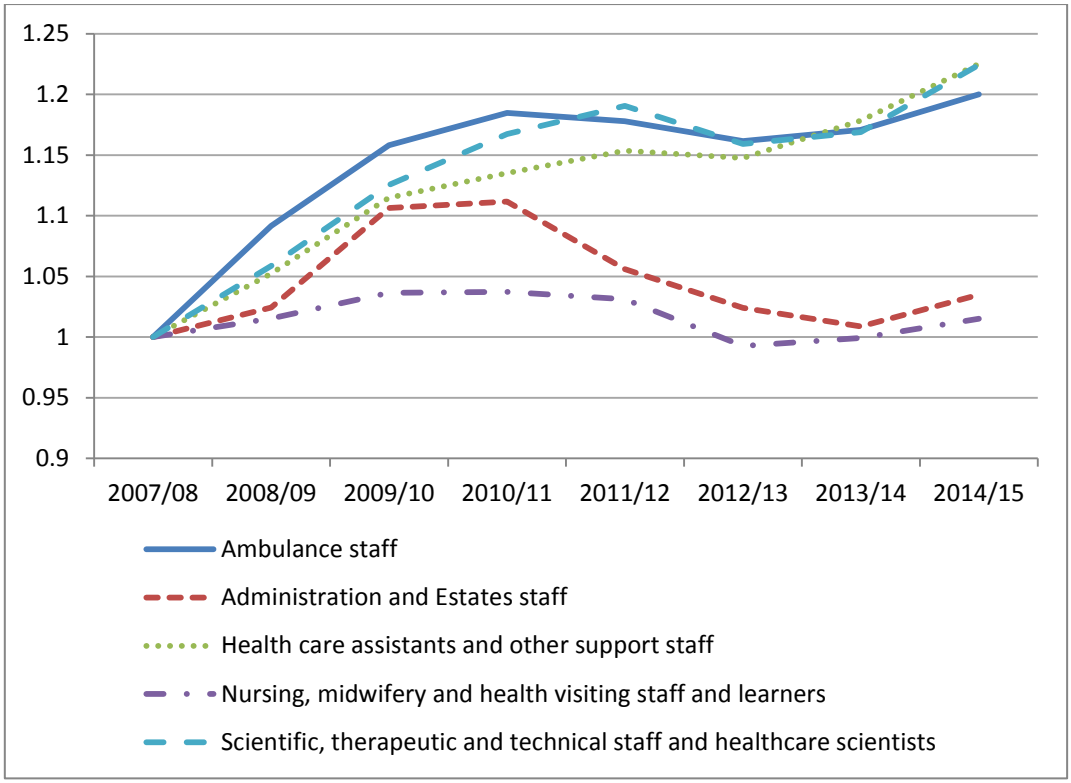


Figure 13: Growth in non-medical staff

Table 38: 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%	0.1%	7.26%
2011/12 – 2012/13	-1.21%	6.27%	-1.97%	5.5%
2012/13 – 2013/14	0.87%	2.24%	0.38%	1.71%
2013/14 – 2014/15	3.67%	3.80%	2.80%	2.92%

*all organisations reporting to ESR except independent providers; arms-length bodies and special health authorities

Table 38 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. As expected, due to wage inflation, the Laspeyres direct labour input growth is always smaller than the nominal growth. Of note, however, is the consistently positive growth in the Trusts only measure and, in particular, the large growth from 2010/11 to 2012/13, which is attributable to the transfer of PCT staff to Trusts via the 'Transforming Community Services' initiative.[17] As Trusts now employ the majority of staff, the hospital Trusts only growth rate and the "All" growth rate look more similar.

[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/229996/Annual_Report.pdf

At 2.80%, the growth rate for labour between 2013/14 and 2014/15 is greater than in previous years. This may be a consequence of the several reports coming out in 2012/13 advising that higher staffing ratios be adopted, namely the Keogh and Berwick reports, and the Francis Inquiry (the latter dealing with poor level of care in the Mid Staffordshire Trust). The reports had a lagged impact, with an upward trend only really observable from September 2013 as shown in Figure 14.

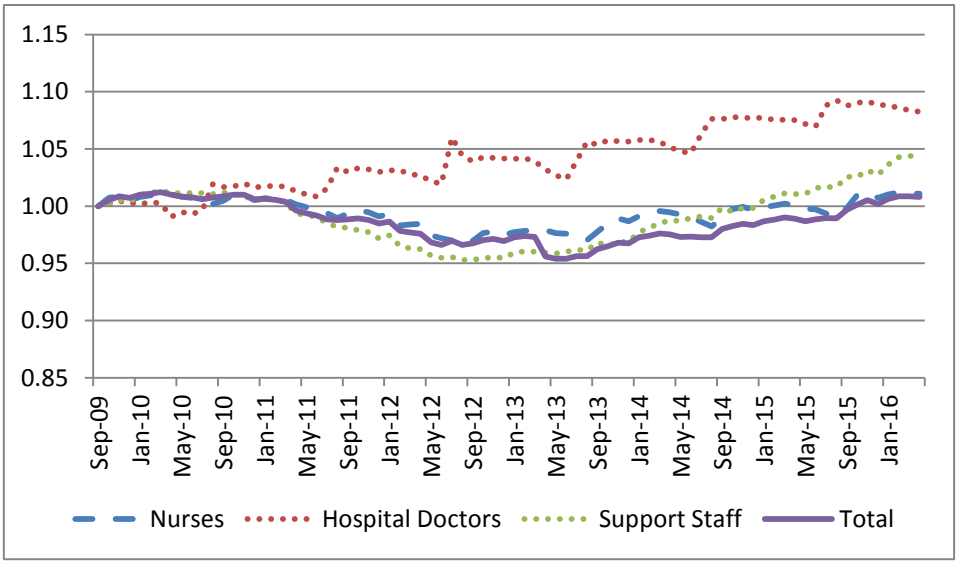


Figure 14: Changes in number of FTEs in different categories by month

3.2 Expenditure data

The source of expenditure data has changed over time and by type of organisation, as summarised in Table 39. 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), which were reported by NHS Trusts, PCTs and SHAs up to and including 2011/12. These provided a detailed breakdown of expenditure on different types of NHS and agency staff, materials and capital items.

The TFRs were discontinued in 2011/12 for PCTs and SHAs. For expenditure data for these disbanding organisations we have relied on aggregated information as reported in the DH Annual Report and Accounts.[18]

For NHS Trusts, TFRs were subsequently replaced with Financial Monitoring and Accounts, although both reporting systems were used in 2011/12. The Financial Monitoring and Accounts are much less detailed than the TFRs, reporting information for very broad input categories, making it no longer possible to report time series for specific input types. For instance, it is not possible to identify expenditure by NHS Trusts on agency staff from this information.[19] Instead, we rely on data provided directly by the Department of Health to identify expenditure on agency staff.[20]

[18] https://www.gov.uk/government/publications/department-of-health-annual-report-and-accounts-2015-to-2016
[19] http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2014-10-22/211600/
[20] For both 2013/14 and 2014/15 the total number of FTEs for agency staff used by Foundation Trusts (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447099/50702_HC_238_WEB.pdf) is available; however, since it is only an aggregate number, we cannot use it in the direct calculation of labour input growth.

Table 39: 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 - 2014/15			N/A	

Other than loss of detail, the more aggregated data have two major implications for the construction of the input index:

1. Rather than input-specific price deflators, we now have to apply deflators for each aggregated input category. This may generate inaccuracy in distinguishing the contributions of changes in volume and prices to expenditure growth.

2. The detail in the TFRs made it possible to account for utilisation of different types of capital in each period, albeit subject to various assumptions about asset life and depreciation (Street and Ward, 2009). The annual accounts, however, do not identify all items of capital. This makes it impossible to ascertain how much has been spent on capital in each period, let alone how much of the capital acquired has been utilised.

The financial reporting lines designated as materials and capital items in the most recent financial data are listed in Table 40 for NHS Trusts and PCTs/SHAs/other organisations, separately.

Table 40: Materials and capital items

Organisation	Materials	Capital
Foundation Trusts and NHS Trusts *Source:* *Financial Monitoring & Accounts* *Consolidated NHS Financial Trusts Accounts*	Services from Other NHS Trusts Services from PCTs Services from Other NHS Bodies Services from Foundation Trusts Purchase of Healthcare from Non-NHS Bodies Supplies & Services - Clinical Supplies & Services - General Consultancy Services Transport Audit fees Other Auditors Remuneration Clinical Negligence Research & Development (excluding staff costs) Education & Training Establishment Other	Premises Impairments & Reversals of Receivables Inventories write downs Depreciation Amortisation Impairments & Reversals of Property, Plant & Equipment Impairments & Reversals of Intangible Assets Impairments & Reversals of Financial Assets Impairments & Reversals for Non-Current Assets held for sale Impairments & Reversals for Investment Properties
PCTs/SHAs/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

3.2.1 Input use derived from expenditure data

Table 41 presents expenditure data reported by PCTs, CCGs and NHS England Group. Expenditure by PCTs had a huge drop in 2011/12, due to the reorganisation of the NHS and the transfer of staff from PCTs to hospital Trusts. 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.

It is not clear which activity was taken over by which organisation. Unlike PCTs, CCGs do not provide clinical activity and it is unclear how the other new organisations share the work previously done by PCTs and SHAs.

Table 41: 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

* 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 42 shows the expenditure for labour, materials and capital for hospital Trusts. **In current terms, labour expenditure increased by 3.3% between 2013/14 and 2014/15. We also observe an increase in spend on materials of 2.3%, whilst capital spend decreases by 6.15% between 2013/14 and 2014/15.**

Table 42: Current expenditure by hospital Trusts (£000)

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

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

The use of agency staff is subject to considerable year-on-year variation, as shown in Figure 15. The substantial increase of 29% between 2013/14 and 2014/15 will contribute to increased overall input growth.

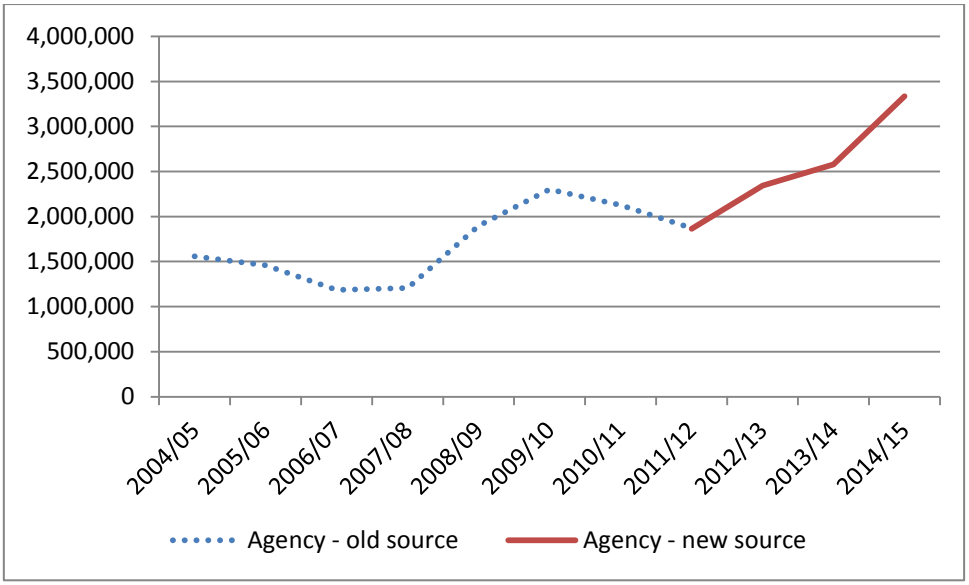


Figure 15: Trends in use of agency staff

Table 43 presents current expenditures for the whole NHS. From 2013/14 onwards, we do not include spend for DH administration. This is due to the restructuring of the NHS and changes to the DH responsibilities. In order to compare like-with-like, we omitted this item of expenditure from the input growth calculations for the years 2012/13 to 2013/14. The 2013/14 to 2014/15 calculations are unaffected.

Table 43: Total NHS current expenditure (£000)

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

*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.

3.3 Input growth

Our measures of input growth are reported in Table 44, differentiated according to the use of the mixed or indirect index. Estimates of input growth have generally been higher if using the mixed rather than the indirect input index. **This is also the case for 2013/14 – 2014/15, where the mixed index suggests a growth rate of 1.94%, while the indirect index suggests that an input growth rate of 1.52%.** This implies that growth in labour inputs between 2013/14 and 2014/15 is greater if using ESR rather than expenditure data.

Table 44: Input growth

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

4 Productivity growth

Year-on-year productivity growth figures over the pair of years from 2004/05 – 2014/15 are provided in Table 45. These figures are constructed by comparing the quality-adjusted output growth rate, as reported in the final column of Table 33, with the estimates of mixed and indirect input growth, as reported in Table 44. **Productivity growth between 2013/14 and 2014/15 is estimated to have been 0.53% based on the mixed method, and 0.95% based on the indirect method.**

Table 45: 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%

We find that, if we use the mixed approach to capture input growth, year-on-year productivity growth has been positive since 2009/10. A similar, but not identical, picture emerges if using the indirect measure, which sometimes suggests higher and sometimes lower changes in productivity. The differences are due to how labour input is measured, with different growth rates if using ESR data *vs* expenditure data.

As can be observed in Figure 16, both input and output year-on-year growth rates generally show downward trends. Where the output line is above the input line the productivity growth is positive, in other cases it is negative.

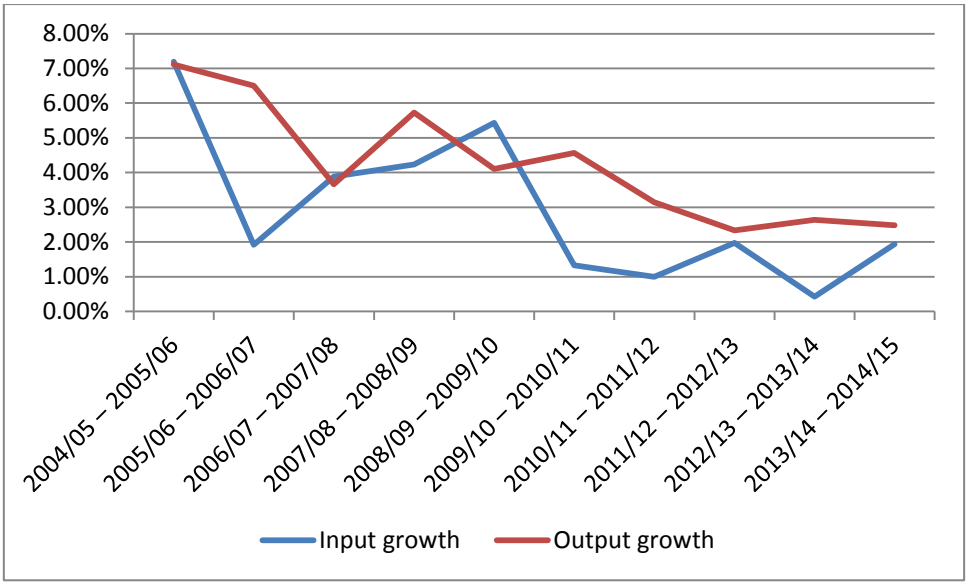


Figure 16: Input and Output growth

Figure 17 presents the input, output and productivity indices over time. We observe slower growth in the input index, which is the main reason why productivity growth is positive.

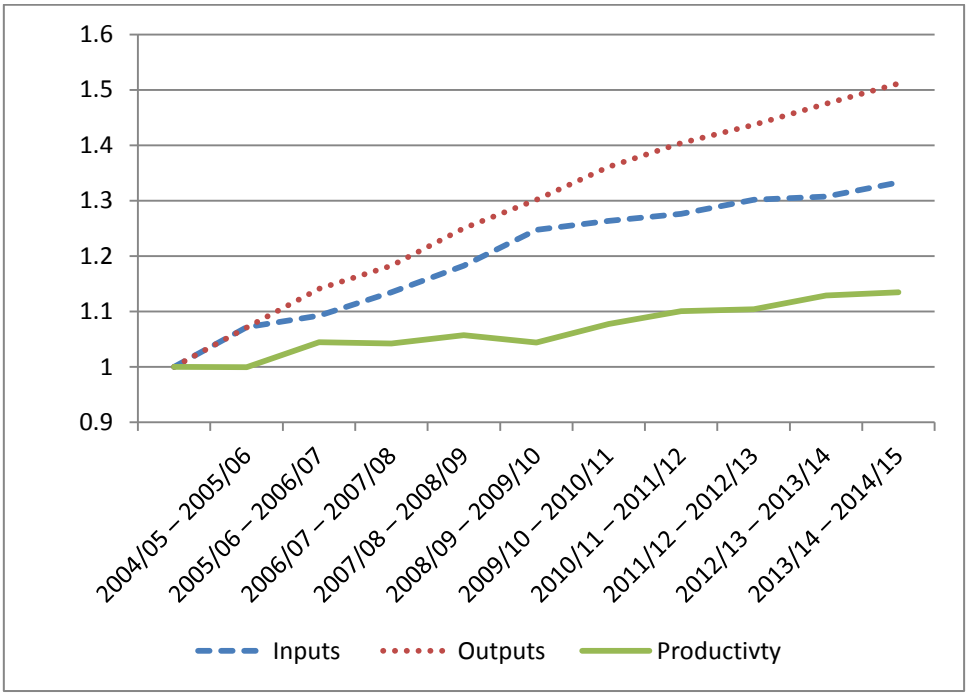


Figure 17 Trends in input, output and productivity growth

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,[21] which is used to measure the contribution to the economy of each sector in the United Kingdom.[22]

[21] 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

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

The rate of NHS productivity growth since 2004/05 compares favourably with that achieved by the economy as a whole. This is shown in the graph below, with NHS productivity growth 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. From 2004/05 total productivity growth was 13.64% for the NHS, compared to only 3.83% in the whole economy.

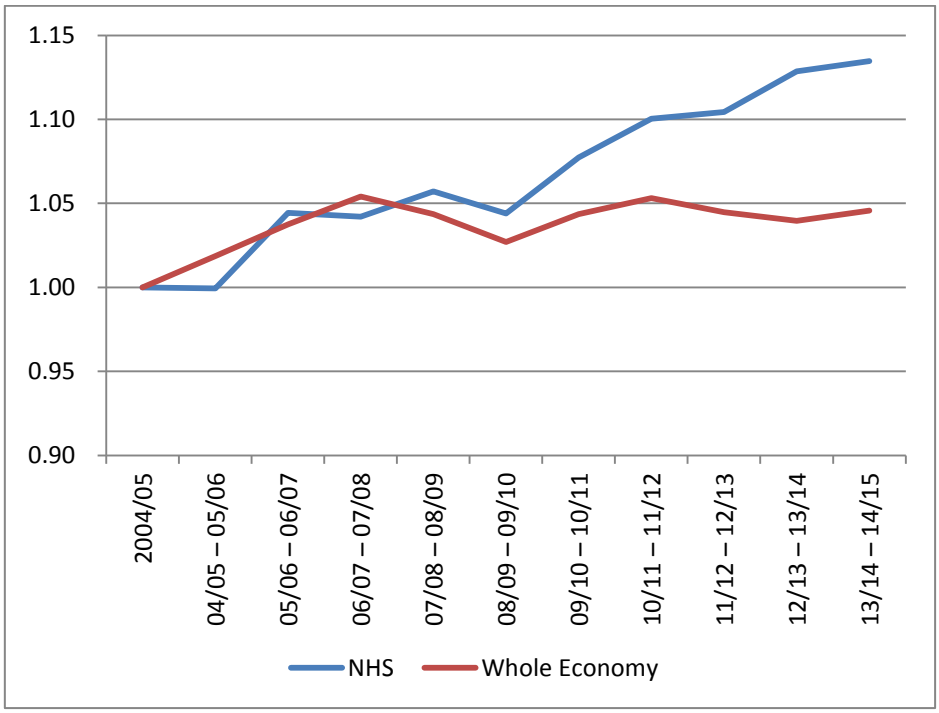


Figure 18 Comparison of productivity growth in the NHS vs Whole Economy

5 Conclusions

Total NHS productivity growth between 2013/14 and 2014/15 amounted to 0.53%, according to our preferred mixed method. This positive year-on-year growth continues a sequence extending back to 2009/10.

Quality adjusted output growth between 2013/14 and 2014/15 amounted to 2.49% for the NHS as a whole, which is very similar to last year (2.64%), but lower than the average over the whole period (4.25%). We observe positive growth across all settings, with the exception of Ophthalmology and Diagnostic Tests. Growth was substantial in both inpatient and outpatient settings, amounting to 2.49% and 3.51%. We observe high growth in the A&E attendances (4.17%) as well as across most of RC categories.

Quality is captured by changes in survival following hospital admission, health status, life expectancy, waiting times, and blood pressure monitoring. There were improvements in some of the quality measures and deteriorations in others, the net effect being a slight overall reduction in quality between 2013/14 and 2014/15. This reduces the output index by 0.04% compared to the cost-weighted output index.

Our indirect measure of input growth indicates a growth between 2013/14 and 2014/15 of 1.52% and our mixed measure (using the direct measure of labour) is 1.94%. Our usual base case measure uses the mixed method, as it is generally recommended to use direct measures of input whenever possible.

Overall, we estimate productivity growth to be 0.95% using our indirect measure and 0.53% based on our preferred mixed method.

In addition to our usual whole-NHS measurement we have also included a measurement for Trusts only, which is contained in Appendix A.3. For Trusts we find output growth of 2.86% and a mixed input growth of 2.27%, leading to productivity growth of 0.58% between 2013/14 and 2014/15.

While both our output and input measures are based on the most comprehensive data available, the usual caveat applies to data on primary care. We continue to apply our standard approach of using survey data to estimate primary care activity. Whilst primary care represents a sizable component of output (approximately 14%) and is therefore an important component of the measurement, use of survey data does not have any obvious sources of bias that may over- or under-estimate our estimate. As a result, it is difficult to predict what effect better primary-care data may have on our estimates. We have reviewed the alternative sources of data on which we might base estimates of primary care activity, and this review is included as Appendix B.

The good news about continued positive NHS productivity growth is tempered by the claim that it is not enough to meet challenges of demand on the NHS over the foreseeable future; the NHS has been set a target of productivity improvements of 2-3% a year (NHS England, 2014). This is higher than the annual average of 1.37% realised since 2004/05. However well the NHS has been doing, the pressure to do better remains.

Nor might these recent productivity gains be sustainable. They have been achieved mainly by restricting growth in staffing levels. But staff numbers have increased in response to the Mid Staffs enquiry,[23] and may do so further if the NHS is to extend the range of services it provides 7-days a week.[24] The NHS, like the economy as whole, faces tough challenges in making continued productivity gains.

[23] https://theconversation.com/creating-new-criminal-offences-wont-help-nhs-patients-16825
[24] https://theconversation.com/why-all-the-fuss-about-a-seven-day-nhs-50020

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Appendix A

A.1 Deflators

We use various deflators to adjust our expenditure series, as shown in Table A1. We use the Hospital and Community Health Services (HCHS) prices index for deflating the expenditure on capital and material goods. For Primary Care expenditure, we use the HCHS pay and prices deflator, while we construct our own deflator for pharmaceutical expenditure. For labour and agency staff we originally used the HCHS pay deflator. The advent of the Electronic Staff Record data has allowed us to construct our own ESR pay deflator, which we have employed since 2011/12. The HCHS and ESR pay deflators are usually quite similar.

Table A1: Deflators used

	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% (0.4%)	1.7%	0.9%	-1.31%

A.2 Technical details

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

$$\Delta TFP = [X/Z] - 1 \qquad \text{(a1)}$$

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

Output growth

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

reflect producer rather than consumer valuations of outputs, but have the advantage of being readily available.

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

$$X^{cq}_{(0,t)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}} \right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \quad \text{(a2)}$$

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

Input growth

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

$$Z^{D}_{(0,t)} = \frac{\sum_{n=1}^{N} z_{nt} \omega_{n0}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} \quad \text{(a3)}$$

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

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

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

$$Z^{Ind}_{(0,t)} = \frac{\sum_{n=1}^{N} \pi_{nt} E_{nt}}{\sum_{n=1}^{N} E_{n0}} = \frac{\sum_{n=1}^{N} z_{nt} \pi_{nt} \omega_{nt}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} = \frac{\sum_{n=1}^{N} z_{nt} \omega_{n0}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} = Z^{D}_{(0,t)} \quad \text{(a4)}$$

As shown, this is equivalent to using volume data, provided that deflators 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. (a2), a chained output index takes the following form:

$$X^{cq}_{(0,T)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \times \frac{\sum_{j=1}^{J} x_{jt+1} c_{jt} \left[\frac{v_{jt} q_{jt+1}}{q_{jt}}\right]}{\sum_{j=1}^{J} x_{jt} c_{jt}} \times \cdots \times \frac{\sum_{j=1}^{J} x_{jT} c_{jT-1} \left[\frac{v_{jT} q_{jT}}{q_{jT-1}}\right]}{\sum_{j=1}^{J} x_{jT-1} c_{jT-1}} \quad \text{(a5)}$$

This can be simplified as:

$$X^{c,q}_{(0,T)} = X^{c,q}_{(0,t)} \times X^{c,q}_{(t,t+1)} \times \cdots \times X^{c,q}_{(T-1,T)} \quad \text{(a6)}$$

where each link is represented by eq. (a2) for the relevant two consecutive years. An analogous construction applies to the chained input index.

A.3 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 A2, **when we look at the activity performed by Trusts only, the quality-adjusted index rises to 2.86%, mainly due to a large increase in Reference Costs activity.**

Similarly, we can also produce a Trusts-only input index. The low growth in inputs, as captured in our NHS input index, may not fully reflect the actual state of this growth: due to the reorganisation of the NHS and the discontinuation of PCTs, we might not be able to fully capture like-for-like inputs data. Therefore, we also calculate the inputs growth for Trusts only, with the rationale being that their reporting may be less affected by the changes. **As shown in Table A2, the input index is much higher when taking only Trusts into account, with a mixed index suggesting growth of 2.27% and indirect index growth of 1.46%**.

Table A2: 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%

Using this information we can produce Trust-only productivity growth figures, estimated as 0.58% for the mixed measure and at 1.39% for the indirect measure.

Appendix B

B.1 Alternative sources of primary care data

Introduction

Although Primary Care spending amounts to around £9 billion a year[25], there is a lack of comprehensive data coverage on even the most basic of activities. Unlike secondary care, community care, rehabilitation and mental health services, there are no routinely collected comprehensive and available datasets from which activity information can be obtained. This situation is unique in our productivity work, as it is the only output setting which requires us to rely on surveys or samples which may not be designed or well-suited to providing national-level summaries of aggregate activity.

This appendix focuses on the issue of volume measurement in primary care in the absence of a single comprehensive good quality dataset, and is structured as follows: we discuss the availability of potential datasets, drawing a distinction between sample and survey sources; we then describe the main results from the main sources of data available and follow this with a discussion of the recent measures of primary care activity and compare them in a productivity framework. We conclude with a discussion of the pros and cons of each method/source comparing sample and survey methods, the means of constructing national figures from the data and draw conclusions about future work.

B.2 Measuring primary care growth

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

$$X^{pc} = \frac{\sum_{j=1}^{J} x_{jt+1} c_{jt}}{\sum_{j=1}^{J} x_{jt} c_{jt}} \qquad \text{(b1)}$$

Where x_j captures the national annual volume of primary care activity of type *j* such as GP surgery consultations, practice nurse consultations, GP home visits, etc. and c reflects the cost of each activity, with t indexing time. The main practical challenge in England is to derive estimates of each type of x_j. Ideally there would be a comprehensive and exhaustive dataset, akin to Hospital Episode Statistics (HES) in the case of secondary care, which routinely captures all activity. Although the data are already being captured by individual practice software management systems, there is no accessible single repository of these.

In the absence of such data, there are broadly two sources of data that can be used: sample-based activity data from GP surgeries, and survey-based estimates from members of the population. With both of these data sources, an additional step is required in extrapolating from the survey/sample results to an estimate of the national total: typically, this will involve multiplying a measure of the number or rate of consultations per person per year by an estimate of the population size.

In what follows, we review various sample and survey data to determine the nature of their activity or response data and the extent to which they can be used to derive estimates of x_j.

[25] http://www.health.org.uk/sites/default/files/HealthFoundationSelectCommitteeSubmissionOnPublicExpenditureInTheNHSAdditionalRequestsForEvidence.pdf

B.3 Sources of primary care activity data

There are generally two types of primary care data sources available: sample data and survey data. The distinguishing feature of ***sample data*** is that the data are drawn from samples of GP practices, whereby all recorded activity undertaken by those practices is included in the sample data. If the sample practices are representative of all practices, recorded activity can be simply scaled up to derive estimates of national-level activity. If the practices are not representative, observed activity will need to be scaled up using appropriate sampling weights to correct for non-representativeness.

The collection of ***survey data*** is aimed at achieving representativeness of the general population, but usually results in the under-representation of some groups, particularly the poorest members of society, either by design or through the process of data collection (Carr-Hill, 2013). Surveys also rely on respondents recollecting events, and any form of self-reporting may bias estimates of health care utilisation (Sutton et al., 1999).

There are additional problems in that the questions asked on surveys may not capture exactly what is required for the measurement of the volume of primary care activity. We would like to know how many primary care consultations patients had over the course of the year. But, for example, the survey which we currently use in calculating primary care activity (the GP Patient Satisfaction survey) asks when patients last saw their doctor or a practice nurse within defined discrete time periods. This necessitates some means of translating survey responses into a total volume of consultations.

Sample based sources available for general research

Examples of sample-based sources from which it might be possible to measure primary care activity include:

- QResearch,
- General Practice Research Database (GPRD), now Clinical Practice Research Datalink (CPRD) GOLD,
- The Health Improvement Network (THIN) ,
- ResearchOne, and
- Somerset CCG data

The first four datasets represent national collections of data, mainly from specific primary care computer systems from general practices which have made their data available for research. All datasets represent complete extracts from the practices' clinical computer systems and contain data for each patient consultation. Data include volumes and types of patient interactions with practice staff such as GP consultations, home visits and telephone consultations as well as practice nurse consultations. As such, the data are sufficient to determine the volume of primary care activity in those practices providing the data. If these are representative of all practices, the information may be used in productivity calculations.

QResearch contains data from approximately 1,000 general practices from across the country using the Egton Medical Information Systems (EMIS) clinical computer system. Although the earliest records are from the 1990s and the database is still ongoing, only summary data are publically available and only from 1995/96 to 2008/09 (Hippisley-Cox and Vinogradova, 2009). It is these data that have formed the foundation for the estimation of volume of primary care activity for that period and, perhaps surprisingly, long beyond 2009. We shall return to this in due course.

The CPRD database is currently owned by the Medicines & Healthcare Products Regulatory Agency (MHRA) and NHS National Institute for Health Research (NIHR), though the origins of the database

stem from 1987, and the database was developed as GPRD from Value Added Medical Products (VAMP) computer systems. At present data are derived from around 690 practices covering 15 million patients across the UK.

THIN also has its roots in GPRD and after 2002 became a similarly structured alternative covering 587 practices and over 12 million patients. Due to both databases originating from GPRD, there is a substantial overlap in both practices and patients, with this amounting to 66% in the case of patient coverage (Carbonari et al., 2015).

ResearchOne is a relatively new database produced by SystmOne software producers TPP in conjunction with the University of Leeds and the UK Government's Technology Strategy Board. This dataset, while promising in terms of coverage, remains in an embryonic stage. Access to it has been limited. Nevertheless a recent King's Fund publication describe the data as covering around 6 million patients and used an extract of 30 million individual contacts with patients in 177 practices between 2010/11 and 2014/15 (Baird et al., 2016).

An issue with CPRD, THIN and ResearchOne is the lack of publicly available information on the practices that participate in either database. Practices may join or withdraw over time so coverage and, hence, representativeness varies year-by-year. If there is an unknown degree of variation in coverage over time, it will be impossible to determine whether changes in observed consultations are functions of changing coverage or changes in volume of consultations. As an example of the extent of this potential issue, although the headline figures for CPRD states that more than 500 practices are participating, there appears to be only 360 practices that are 'actively' participating (Hobbs et al., 2016).

The Somerset Symphony data are available from an unrelated CHE project, which addressed the impact of greater collaboration between primary, community, mental health, acute and social care, particularly for people with complex conditions (Kasteridis et al., 2015). These data contain summarised data on GP activity for the whole population of Somerset 2012/13 to 2013/14. This dataset has been made available for the purposes of comparison and we are grateful to Somerset CCG for their permission to use the data. It is likely that other CCGs also collect similar data.

Coverage and representativeness of sample datasets

Ideally, sample-based databases would contain data from randomly selected practices or practices that are representative of the broader population of practices and patients. Unfortunately selection into these data sets is not random, appearing to be mostly driven by the type of software used by each practice (e.g. EMIS for QResearch). Representativeness of the data is rarely explored in any detail by the data providers, with the exception of QResearch which has made an explicit attempt to assess the representativeness of the data sample and apply a set of weights to estimate a national figure (Hippisley-Cox and Vinogradova, 2009).

While CPRD GOLD is often commonly cited as being a broadly representative sample, the sole source of publicly available information regarding its representativeness comes from a published conference abstract (Campbell et al., 2013), which states:

> *There were 4.6 million patients on Census Day in GOLD, 7.3% of the UK population with little variation by gender but a lower representation of younger age patients. Crude death rates were nearly identical to national rates (8.70 per 1,000 vs. 8.69 in GOLD). ASMR in GOLD were lower than national rates by 11% in men (582.8 per 100,000) and 8.6% in women (426.9 per 100,000), with only slight variation by country. Age-specific MR's among the GOLD population*

> *ranged from 3% to 25% below those reported for the UK population except among children ≤ 10 years where MR's were more than 50% lower. The median list size was higher in GOLD practices (England 8,355 pts., Scotland 5,998 pts.) than for all England (5,918 pts.) and all Scotland (4,943 pts).*

Far from confirming that CPRD is broadly representative, the figures suggest that the sample differs from the general population in several important respects.

It is difficult to correct for non-representativeness even with regression-based modelling to derive sampling weights. This is because the weights are based on observable characteristics such as practice list size and composition, or geographical location. But participation may be based on unobserved factors, such as the inclination of practice staff to engage in research or continued professional development, and these factors may also influence the volume and distribution of activity. If so, then the measured activity of an included practice may not be reflective of the activity of other practices, even though they may look similar on the basis of observed characteristics. In such cases, sampling weights based on regression models will still produce biased estimates of national activity, with the nature of this bias being unknown.

A further issue with many of these datasets is the evolving and fluctuating nature of the coverage of the data, with new practices joining and old practices dropping out. This makes it difficult to measure the proportion of coverage. Without a clear idea of the coverage, it is difficult to produce national estimates of activity. It is perhaps not surprising that Kontopantelis et al conclude that '*Researchers need to be cautious when generalising findings from samples of providers using a single computing system*' (Kontopantelis et al., 2013).

Possibly due to the more rigorous attempts to assess consistency over time and representativeness of the sample, the QResearch database has been the most popular sample-based means for deriving national estimates of both the volume and composition of primary care use. Indeed QResearch was used as the source of estimates of primary care activity in national productivity calculations until 2009, the point at which QResearch became publicly unavailable. Even now, despite the lack of contemporary data, QResearch remains the prime data source for many of the current estimates of primary care activity. These include those produced by ONS and the Deloitte estimates of 370m consultations per year (Deloitte, 2014), which were reported by Maureen Baker, Chair of the Royal College of GPs at the 2016 Special Local Medical Committees (LMC) Conference.[26]

Survey based measures of primary care service use data

Many national surveys ask people about their contacts with primary care providers. The form of the question varies across surveys and over time. These questions can be used to provide insight into the frequency and type of contact with primary care, provided that some relationship can be posited between the survey response r and the amount of primary care activity $\tilde{x}_j$ provided to those questioned, such that $\tilde{x}_j = f(r)$. Survey data also tend to need to be scaled to derive estimates of national levels of the different types of activity, such that $\tilde{x}_j \delta_j = x_j$.

In what follows, we review various survey data to determine the nature of their activity or response data and the extent to which they can be used to derive estimates of x_j.

[26] http://www.rcgp.org.uk/news/2016/january/maureen-baker-speech-lmcs-conference.aspx

There are a number of large scale surveys which may potentially contain data on primary care activity. We have identified the following:

- GP Patient Survey
- British Household Panel Survey (now part of Understanding Society)
- Health Survey for England
- General Lifestyle Survey (formerly General Household Survey)

In general, the surveys are designed such that they aspire to be representative of the general population. They do however introduce a few other problems, the main ones being that they capture reported rather than actual behaviour, that the questions used may not completely capture the information required for productivity calculations, that there may be inconsistency over time in how questions are asked, and that the aspiration of representativeness may not be realised.

The GP Patient Survey is a twice-annual questionnaire sent to approximately 1.32 million adults registered with a GP in England. The aggregate results represent the current source of data for our productivity measure. The questionnaire asks a simple question about when a respondent last saw or spoke to a GP from their surgery. Responses are categorised in ordered temporal categories: in the past 3 months; between 3 and 6 months; between 6 and 12 months; more than 12 months; never. An additional question asks whether a nurse had been spoken to. GP Patient Survey data are available since 2007. However, the questionnaire underwent a major restructuring after the June 2011 publication, including a revised weighting scheme, in order to better adjust for socio-economic characteristics of the sample. Survey documentation states that post-June 2011 results should not be compared with pre-June 2011 results.

The British Household Panel Survey (BHPS) was a multi-purpose survey with a unique approach in following the same representative sample of individuals over a period of years. The survey began in 1991 and ran to 2008 (wave 18), and consisted of approximately 8,000 households. From 2010 onwards the survey was incorporated into the 'Understanding Society: The UK Household Longitudinal Study' which now features approximately 40,000 households including most of those remaining in the last BHPS wave. The Understanding Society study has been running since 2009 (wave 1) and data are available up to and including Wave 5 (2014). Questions on health service use were initially dropped during the incorporation of the BHPS into the Understanding Society study. However, wave 7, which started in Q1 2015, featured a new question regarding visits to the GP within the last 12 months. Responses are in ordered categories: none; one to two; three to five; six to ten; and more than ten. Given the recent introduction of this question, the earliest that this could be incorporated into productivity calculations would be for the 2015/16-2016/17 measure.

The Health Survey for England (HSE) for 2013 contains data on the use of health services, including GPs. Specific questions include how many times a patient talked to their GP in the past 2 weeks, the number of contacts, and where the contact took place. It also has additional questions regarding how many times a patient talked to a GP within the last year. The questions do not appear to be consistent over time (and they do not appear at all in HSE 2012) but going forward they may represent an alternative data source.

The General Lifestyle Survey (formally General Household Survey) ran from 1971 to 2011. Data about the type and volume of GP consultations was collected from 1971-1996, in 1998 and from 2000-2011. The latest versions of the survey ask about the number of contacts with a doctor and with a nurse practitioner during the previous two weeks. Further questions also ask about location (telephone; home; surgery; health centre; other).

Our conclusion is that some survey data appear to be improving over time in their suitability for the purposes of calculating productivity. It may be possible that, for the 2015/16-2016/17 measure, the Health Survey for England contains questions which are more suited to productivity measurement. At the very least, it will provide an alternative source for comparison and triangulation.

B.4 Key findings from the main data sources

In this section we detail the main findings from the three key sources of data that are available, have been used or show potential for use in calculating primary care activity and growth figures. They are:

- QResearch 1995/96 to 2008/09;
- GP patient survey 2011 – 2016 (ongoing); and
- Somerset Symphony Project data 2012/13 – 2013/14 (ongoing).

QResearch

The final QResearch report available (Hippisley-Cox and Vinogradova, 2009), represents a major data source in understanding primary care activity but the fact it was last reported for 2008/09 represents a limitation for any current estimates. Some current estimates of primary care activity are simple extrapolations of the trends over the observed period of fourteen years for which QResearch data were available to more recent years, but these estimates fail to take advantage of contemporary data.

The key data from QResearch are: the average number of consultations per person-year over time; the distribution of consultation rates across the population; proportion of consultations by staff type and by location. All graphs are taken from the original QResearch report.

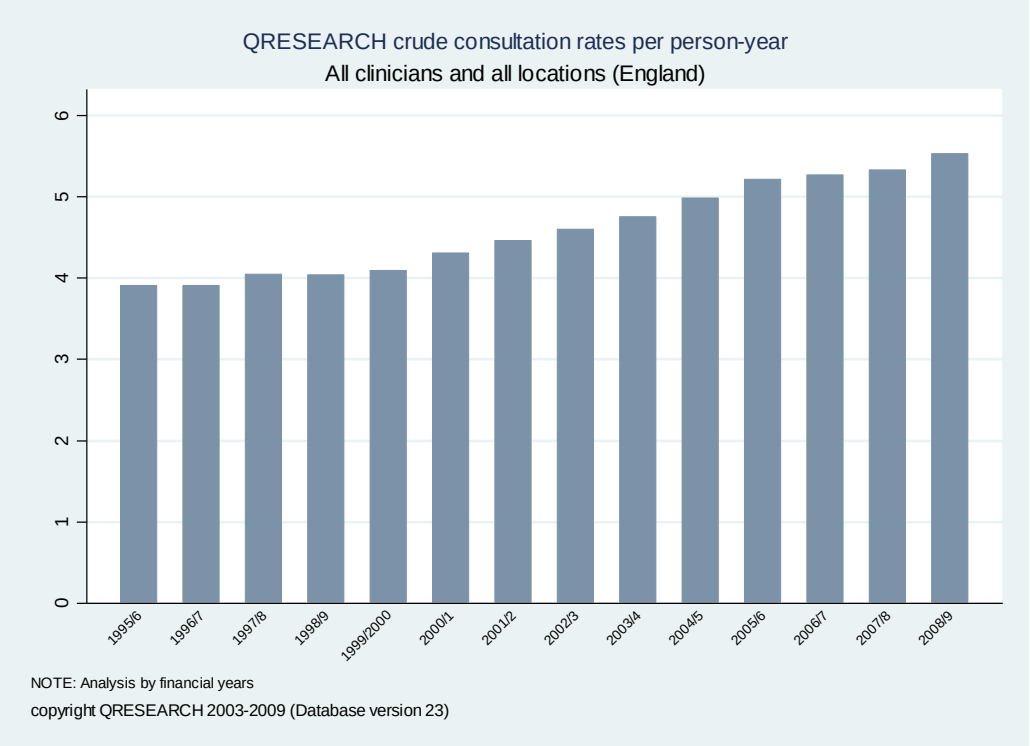

Figure B1: QResearch consultation rates per person-year, 1995/96 – 2008/09

Figure B1 shows the average crude consultation rates over time and shows, especially from 1999/2000 onwards, a fairly linear trend of increase over time. The rates range from an average of

3.91 consultations per person per year in 1995/96 to 5.53 consultations per person per year in 2008/09.

QResearch also reports estimates of total consultations in England. This is a function of both consultation rates and total population and is shown in Table B1. Population weights were determined by use of a linear regression model to correct for the QResearch sample not being a random sample of all practices or the general population. Weights included age-sex standardisation, practice size, mortality rates and Townsend deprivation scores. The table also shows the 95% confidence interval for total consultations, the variation driven by the sampling uncertainty surrounding the estimates of the consultation rates.

Table B1: QResearch estimates of consultation rates and volume for England (000s)

Financial year	Adjusted mean of consultation rates	Total registered population	Estimated number of consultations in England	95% CI for consultations	
1995/96	4.45	50,400	224,500	205,900	243,100
1996/97	4.39	50,600	222,000	203,700	240,400
1997/98	4.34	50,900	220,700	204,700	236,800
1998/99	4.30	51,100	219,900	205,400	234,500
1999/2000	4.30	50,900	218,900	205,600	232,300
2000/01	4.39	51,300	225,300	212,300	238,300
2001/02	4.66	51,300	239,000	226,700	251,300
2002/03	4.78	51,500	246,200	235,500	257,000
2003/04	4.92	52,700	259,400	249,500	269,300
2004/05	5.04	52,500	264,900	255,300	274,500
2005/06	5.30	53,400	283,200	274,300	292,000
2006/07	5.41	53,900	291,500	282,500	300,600
2007/08	5.41	53,900	291,900	282,800	301,100
2008/09	5.64	53,900	303,900	294,200	313,600

Table B1 shows a number of interesting features of the data. Firstly, the total increase in consultations from 1995/96 to 2008/09 (35.4%) has largely been driven by increases in consultation rates (21.6%) rather than increases in population size (6.9%). The second feature is the relatively wide 95% confidence intervals, implying substantial uncertainty surrounding the estimated consultation rates despite the huge sample size. Statistical tests show that, in these in 13 years of paired growth measures, only one year (2004/05 to 2005/06) exhibits a growth in consultations statistically significant from zero.

Calculation of productivity figures requires a distinction to be made between the types of consultations, principally the member of staff that undertakes the consultation and the location of the consultation. Costs differ across these categories, so changes to the distribution of the consultations may have an important impact on estimates of the volume of primary care activity.

Table B2 shows the 2008/09 breakdown of consultation types and locations as used to define distinct primary care activities in the CHE productivity measure.

Table B2: 2008/09 Q-Research distribution of consultation types

	GP home visit	GP telephone	GP surgery	GP other	Practice nurse	Other clinicians
All consultations	2.00%	6.23%	52.86%	1.83%	33.49%	3.60%
Just GP consultations	3.17%	9.89%	84.02%	2.91%		

Figure B32 shows the declining proportion of consultations taken by GPs relative to those taken by practice nurses, with rates for GPs having steadily fallen from 75% in 1995/96 to 62% by 2008/09. Figure B3 shows declining rates for combined GP surgery consultations and home visits, and a significant increase in telephone consultations. The volume of telephone consultations has risen every year since 1995/96.

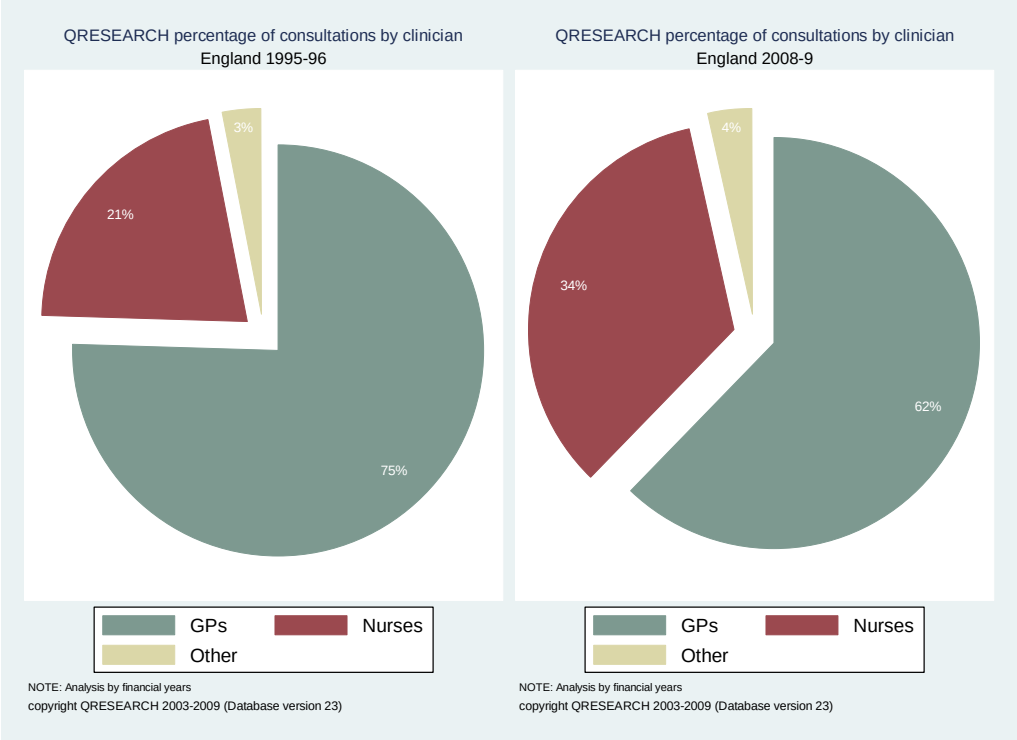

Figure B2: Percentage of consultations by clinician

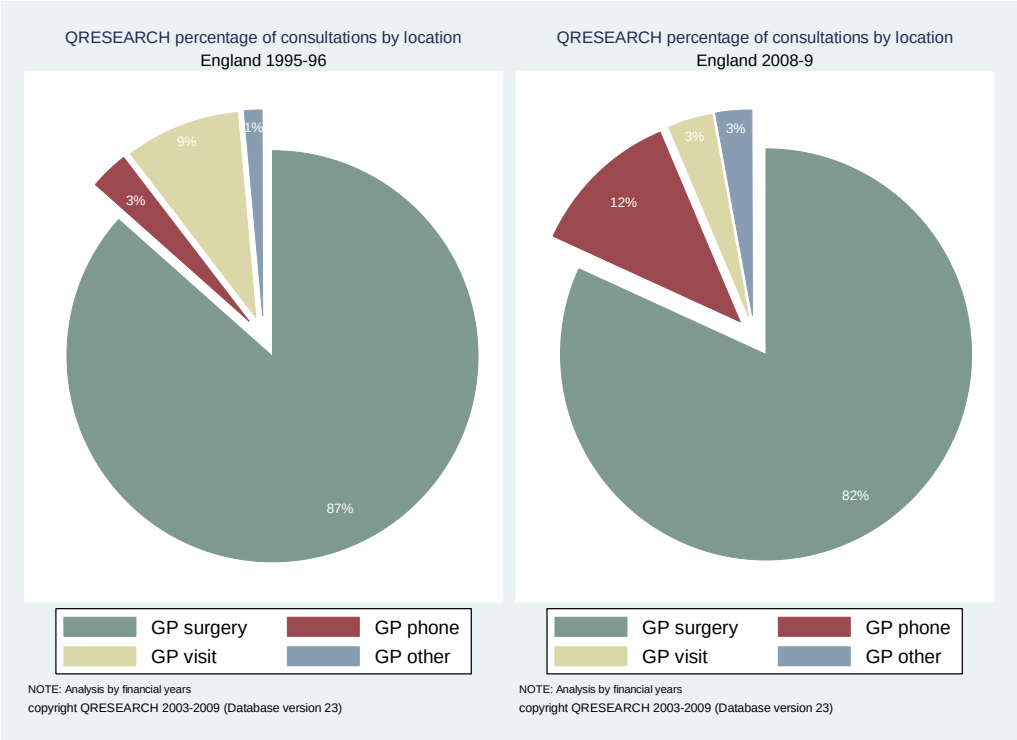

Figure B3: Percentage of consultations by location

GP Patient Survey

The GP Patient Survey gives percentages of patients who report having contact with their GP or primary care nurse within time-frames of 3, 6, 12 months and beyond 12 months (and by default, never). Although these data are clearly related to the actual number of GP and nurse consultations they are not entirely equivalent.

Table B3: GP appointment

Report date	Financial year	Within 3 months	3-6 months	6-12 months	12 months +
2012-Jun	2011/12	54.00%	17.62%	13.77%	13.25%
2013-Jun	2012/13	54.83%	17.52%	13.52%	12.82%
2014-Jul	2013/14	54.28%	17.57%	13.79%	13.04%
2015-Jul	2014/15	53.38%	17.63%	14.05%	13.54%

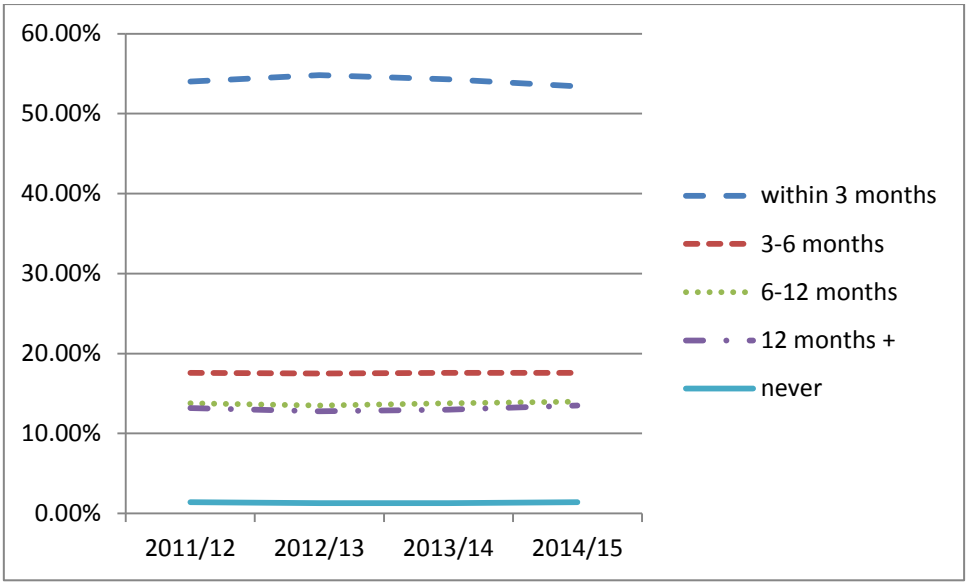

Figure B4: Last spoke to or saw a GP

Table B4: Practice nurse consultations

Report date	Financial year	Within 3 months	3-6 months	6-12 months	12 months +
2012-Jun	2011/12	35.05%	16.93%	16.22%	24.11%
2013-Jun	2012/13	35.80%	16.97%	16.21%	23.66%
2014-Jul	2013/14	35.91%	17.01%	16.23%	23.61%
2015-Jul	2014/15	35.86%	17.92%	16.89%	22.12%

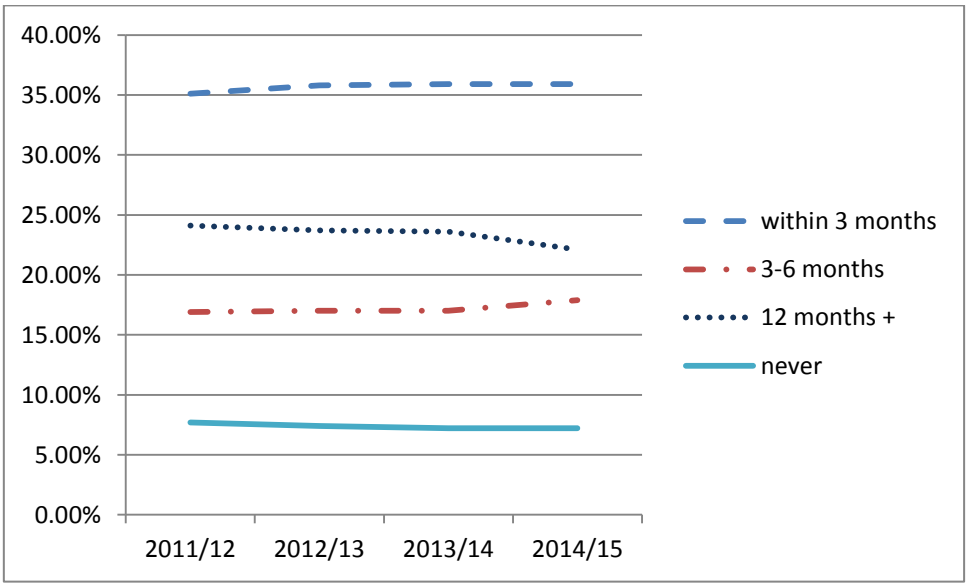

Figure B5: Last spoke to or saw a nurse

The GP Patient Survey suggests that fewer people are seeing GPs within 3 months and more are not seeing their GP in the previous year or, indeed, ever (as shown in Table B3 and Figure B4). There has been an increase in the proportion seeing a practice nurse within 3 months, and a decrease in the proportion never seeing them (as shown in Table B4 and Figure B5). The proportions in each time frame are erratic from year to year.

Although the years of the GP Patient Survey do not overlap the QResearch timeframe and so a like-for-like comparison is not possible, the lack of a systematic growth in the numbers of the population seeing their GP within 3 months suggests that the growth in rates observed up to 2009 has not continued.

Somerset Symphony Project data

Somerset's Symphony Project is designed to establish greater collaboration between primary, community, mental health, acute and social care, particularly for people with complex conditions (Kasteridis et al., 2015). For the purpose of the project, a large dataset was created which links acute, primary care, community, mental health and social care data for each individual in the Somerset population. The data are derived from various primary sources, all of which cover twelve months and are compiled into two annual datasets. The datasets contain anonymised individual-level data about what care has been received and at what cost across all care settings. Using these data for measuring primary care activity gives us an alternative data source which is comprehensive and of high quality. However, the sample is limited to those living in Somerset and so may not be representative of the whole of England.

The Somerset Symphony Project database contains data for every occasion a patient interacted with the GP Practice, either through a physical visit (either with a GP or other health professional) or an event recorded in the patient's medical record 'in absentia', such as a telephone consultation. The data capture patient interactions within their general practice including face-to-face contacts and telephone consultations. These data are summarised in Table B5.

Table B5: Somerset GP practice interactions

General practice consultations within year, *C*	2012/13		2013/14	
	Nr	%	Nr	%
0	149,267	26.1	165,778	28.68
1	80,067	14	78,867	13.65
2	61,580	10.77	60,152	10.41
3	48,996	8.57	47,308	8.19
4	39,485	6.9	38,073	6.59
5	31,818	5.56	30,778	5.33
6	26,145	4.57	24,906	4.31
7	21,124	3.69	20,605	3.56
8	17,426	3.05	16,684	2.89
9	14,563	2.55	13,600	2.35
10	12,050	2.11	11,579	2
>10	69,467	12.14	69,652	12.05
Total Population (N)	571,988	100	577,982	100
Total Activity, *C* × *N*	2,640,635	--	2,604,078	--

We can observe the total number of interactions by multiplying the number of people in different activity levels with the actual activity (e.g. 61,580 multiplied by 2, as this many people had 2 interactions). The total numbers of interactions in 2012/13 and 2013/14 were 2,640,635 and 2,604,078 respectively, a fall of -1.38% despite a 1.05% increase in population. Average interactions per member of the population fell from 4.62 to 4.51, and the standard deviations of consultations are 6.6 and 6.7 respectively. The mean is considerably lower than the rate of around 5.6 interactions per person suggested by QResearch (for 2008/9)

Of note is the high proportion (approximately 28%) of the population who had no interactions with the practice and the relatively high numbers (approximately 12%) who had over 10 interactions with the practice. These data show substantial heterogeneity in rates across the population.

It is possible to cross-reference these data with that in the GP Patient Survey, which is also reported at CCG level. Table B6 summarises the activity from the GP Patient Survey for the Somerset CCG.

Table B6: Somerset CCG GPPS survey results

Report Date	within 3 months	3-6 months	6-12 months	12 months +	never
12/13	54.28%	16.88%	13.79%	13.49%	0.94%
13/14	51.59%	18.39%	14.09%	14.58%	1.26%

When we compare the activity reported in the survey to the activity levels from the Somerset Symphony Project data, we observe marked differences, especially for the number of individuals who have not seen the GP in the past year. The survey data suggests that 14.4% (ie 13.49%+0.94%) and 15.8% of people in Somerset CCG had no GP appointments in 2012/13 and 2013/14 respectively. In contrast, the Somerset Symphony Project data suggest that 26.1% in 2012/13 and 28.7% in 2013/14 of individuals had no interactions with primary care.

While the Somerset Symphony Project dataset is a complete count of activity, the survey data relies on a small subsample. Nationally, from 19,941 surveys that were sent out in 2013/14 (20,819 in 2012/13), less than half (9,909, 48%) were returned (8,948, 45% in 2012/13).

These much lower estimates of primary care usage call into question the reliability of using survey data.

B.5 Current and proposed methods of measuring primary care activity

This section details various measures of primary care activity which can be used to compare the estimates of activity growth from each measure.

Extrapolations based on QResearch data

The RCGP recently claimed that *'GPs are conducting at least 370m patient consultations every year – 60m more than five years ago*.'[27] Both of these figures were taken from a 2014 Deloitte report, originally designed to estimate a presumed "funding gap" in general practice, but from which most claims regarding primary care consultation counts have subsequently been drawn (Deloitte, 2014). For example, the NHS England Annual Accounts for 2014/15 states that "around 340 million GP consultations took place".[28] While no method or reference is provided for this figure, NHS England's

[27] http://www.rcgp.org.uk/news/2015/november/poll-results-show-general-practice-struggling-to-cope-with-tsunami-of-increased-patient-demand.aspx
[28] https://www.england.nhs.uk/wp-content/uploads/2015/07/nhse-annual-report-2014-15.pdf

website provides presentation slides entitled "Improving General Practice – a call to action" which state this estimate for 2013/14.[29] As with Deloitte's figures, this appears to be based on a straight line extrapolation from QResearch data collected between 1995 and 2008, without population adjustment. This figure was also cited in the Keogh Report as an estimate for 2012/13[30], with the same source cited.

The Deloitte report is somewhat opaque on the method adopted to extrapolate figures, stating:

> *"The linear trend in the consultation rate between 1994 and 2008 has been used to forecast consultation rates for each age band until 2018. These forecast consultation rates are applied to forecast population estimates (ONS) in order to estimate the total number of consultations."*

Table B7 reports the estimates of consultations from the last observed figure (2008/09) to the 2017/18 estimates. While few details are provided about the method adopted, we are able to replicate these results. It appears that the estimates in the Deloitte report are constructed from observed population figures for England, grouped into five-year age bands. Estimates of population growth rates for each of these five-year age bands are constructed from an extrapolated linear trend growth by age band between 1995/96 and 2008/09. The point estimate for 2008/09 QResearch's consultation count for each age band is scaled up by the implied growth rate on the basis of the estimated population growth.

Table B7: Deloitte estimates of general practice consultations

Year	Consultations (000s)
2008/09	303,900
2009/10	314,585
2010/11	327,159
2011/12	338,435
2012/13	349,319
2013/14	360,838
2014/15	372,471
2015/16	384,303
2016/17	396,656
2017/18	409,306

There is ample reason to treat with caution the accuracy of estimates derived using this method. All predicted consultation figures (from 2009/10 onwards) are built on applying an observed historical trend growth to a single survey-based estimated figure: the 2008/09 QResearch point estimate of 303.9m consultations. Note that even this figure is uncertain; there being a 95% confidence interval of 294.2m to 313.6m.

Furthermore, it is important to distinguish between consultations in general practice, and consultations carried out *by general practitioners*. There may have been changes in the composition of consultations according to staff type. The QResearch survey figures aggregate all types of consultations: from 1995/6 to 2008/9, consultation rates rose from 2.95 to 3.44 per person per year

[29] https://www.england.nhs.uk/wp-content/uploads/2013/09/igp-cta-evid.pdf
[30] http://www.nhs.uk/NHSEngland/keogh-review/Documents/UECR.Ph1Report.Appendix%201.EvBase.FV.pdf

(pppy) for GPs, and from 0.84 to 1.90 pppy for nurses. In 1995/96 GP surgery consultations made up 76% of all consultations and nurse consultations 22%; by 2008/9 these proportions were 62% and 34% respectively. Breaking down the Deloitte estimates, by including a linear extrapolation of the changing make-up of consultations in general practice, implies the following estimates for general practice consultations carried out by GPs, nurses, and others (Table B8).

Table B8: Deloitte volume of consultations by type

Year	Total consultations (000s) [Deloitte]	GP consultations (000s)	Nurse consultations (000s)	Other consultations (000s)
2008/09 [survey]	303,900	189,050	104,197	10,653
2009/10	314,585	193,954	109,810	10,822
2010/11	327,159	199,997	116,110	11,052
2011/12	338,435	205,220	121,978	11,236
2012/13	349,319	210,191	127,723	11,405
2013/14	360,838	215,527	133,718	11,593

Such an adjustment points to a large estimated growth in consultations carried out by nurses (28%, or 29.5m) between 2008/09 and 2013/14. The estimated rise in the number of GP consultations is smaller than this, both proportionately (14%) and even as a raw count (26.5m).

CPRD-based analyses

Two publications have been found which use CPRD data to analyse primary care workload – a Nuffield Trust blog estimating the number of consultations for each financial year between 2010/11 and 2013/14 (Curry, 2015) and a Lancet publication which estimates the number of consultations over a longer period, between 2007/08 and 2013/14 (Hobbs et al., 2016).

The key objective of the Nuffield blog was to challenge the simple extrapolation assumption that underpins both the Deloitte and NHS England estimates of primary care activity. They analysed CPRD data from 3.2 million patients from 337 practices in England between 2010/11 and 2013/14 – this would appear to cover the 'active' participants in CPRD at this time. They report the number of consultation types per patient per year as shown in Table B9.

Table B9: Nuffield Trust and Hobbs et al estimates of consultations per person

Year	Curry (2015)					Hobbs et al. (2016)		
	Total GP	Total Nurse	Total Nurse & GP	Total other	Total (All)	Total GP	Total Nurse	Total Nurse & GP
2007/08						3.35	1.32	**4.67**
2008/09						3.43	1.35	**4.78**
2009/10						3.52	1.39	**4.91**
2010/11	3.43	0.98	**4.41**	3.16	7.57	3.57	1.37	**4.94**
2011/12	3.49	1.02	**4.51**	3.44	7.95	3.64	1.37	**5.01**
2012/13	3.55	1.05	**4.6**	3.61	8.21	3.76	1.38	**5.14**
2013/14	3.49	1.06	**4.55**	3.74	8.29	3.8	1.36	**5.16**

Curry finds that the number of consultations per person has risen in line with those produced by extrapolating the QResearch data, but only when the 'others' category is included. As such, one of the key conclusions drawn is that the growth in consultations has largely been driven by non-GP practitioners: whereas GP consultations rose by around 0.6% per annum, 'other' practice staff (including pharmacists, physiotherapists, speech therapists, etc.) has risen by 5.8% per annum and now represents the largest component of primary care activity. In total all practice consultations rose on average by approximately 3% per annum.

If we limit the consultation rate to just those undertaken by nurses and GPs we find a much smaller growth rate over the period of just 1.1% per annum. In fact, there was a fall of 1.7% (from 4.6% to 4.55%) between 2012/13 and 2013/14. The author also raises concerns regarding the representativeness of the sample and cites potential coding discrepancies and a lack of clarity over how some patient contacts are recorded across practices.

Hobbs et al. adopt a similar approach using a cut of CPRD data that overlaps that of the Nuffield Trust analysis, for the years from 2007/08 to 2013/14. Their data cover 398 practices, of which 360 contributed to the first four years of the analysis, with this figure declining to 316 in the final year. They find that the contributing practices tended to be large with mean practice sizes in excess of 9,000 patients, mostly from the South of England and over-representative of those achieving high QOF scores. Hobbs et al. also excluded the contribution of 'other' practice staff from their calculations.

Hobbs et al. report average per annum growth rates of 2.1% and 0.51%, respectively for GPs and nurses over the whole time period, and an average annual total growth in activity rates of 1.7%. In terms of GP consultation type makeup, an average 87% over the whole time period consists of face-to-face visits at the surgery, an average 10.5% of telephone consultations and an average of 2.4% of home visits. There is a noticeable increase from 8.1% to 14.2% in the share of telephone consultations over the period, while the share of face-to-face consultations decreased from 89.3% to 83.7%.

In addition to the rates and types of consultations, Hobbs et al. also looked at the duration of consultations, which has risen from an average of 8.45 minutes in 2007/08 to 8.86 minutes in 2013/14.

It is informative to compare rates of consultations for GPs and nurses across studies over the same time period 2010/11 to 2013/14 from these two analyses. Given what would appear to be a substantial overlap in the data used, we would expect very similar results. However, there are fairly substantial differences in calculated rates. In general, Hobbs et al. calculate total rates that are approximately 0.55 per person per year above those reported by Curry. Moreover, that overall difference masks two diverging trends between GPs and nurses. For GPs, Hobbs et al. calculate an average per annum increase of over 2%, whilst Curry calculates a rate closer to 0.6%. For nurses, Hobbs et al. calculate an average annual growth rate of -0.24%, whereas Curry calculates a growth rate of 2.7%.

The degree of difference between the two analyses, despite using the same data, is substantial and raises issues about the conclusions that can be drawn from using the CPRD data. Although practice coverage may not be completely comparable across the two analyses, it seems unlikely that this could be the cause of such differences. The differences may be due to sampling variation, but it raises the question of how reliable a sample-based method from a non-representative sample of practices may be if sampling variation is so high.

Comparison of approaches in calculating volumes

The data available permit comparison of results across alternative measures. In order to calculate raw number of consultations, we used the estimates of the average number of consultations and applied them to the ONS population estimates. To construct the number of consultations, we assumed the starting year (2008/9) is the same as the figure provided by Deloitte and is based on the QResearch data (Hippisley-Cox and Vinogradova, 2009).

All measures follow the same basic framework: an estimate of consultation rates per population in a specific year is applied to population estimates in that year. Growth in the volume of consultations may therefore be a function of rate growth and/or population growth.

The Deloitte measure extrapolates an observed two-year linear trend between 2008 and 2009 up to 2013/14, accounting for changes in age and gender (Deloitte, 2014). This growth in consultation rates is applied to contemporary measures of population growth available from the ONS. Rather than extrapolate a trend last observed in 2009, the CHE approach uses contemporary survey data to estimate changes in the rate of consultations as measured by changes in the probability of seeing a GP within the past 3 months (Bojke et al., 2016a). These measures of changes in rates are then applied to the same population growth estimates as the Deloitte approach. The Deloitte approach applies the changes and rates over time to a fixed anchor point of the last point estimate from the QResearch.

Neither Hobbs et al. nor Curry, the two CPRD based studies, directly estimate volumes of consultations (Hobbs et al.2016, Curry, 2015). Nevertheless, by applying the published estimated rates of the CPRD consultations per population or age/gender categorised population to the ONS population estimates, we are able to obtain measures of volume in an analogous manner to that of Deloitte. As the source data for each study contains considerable overlap, then we would expect a high level of agreement between these two estimates, indeed they should not be considered as independent in the way perhaps the CHE and Deloitte estimates are. As the Curry study provided just overall population consultation rates, some differences may occur due to the more aggregate nature of population growth measures.

The calculation of national volumes of consultations from the Somerset data (Kasteridis et al., 2015) is constructed by applying the observed average (yearly) rate of primary care appointments to the entire population.

The ONS reports estimates of growth rates, which also used QResearch data up until the point that the data were no longer made publically available, are included for purposes of comparison (Office for National Statistics, 2015).

Table B10: Comparison of numbers of consultation: GP and Nurse consultation total (000s); incl. setting "Other"

Method / Data	CHE	Deloitte	ONS-existing	Curry 2015	Hobbs et al 2016	CHE Somerset data
	Survey (3 months)	Extrapolation	Extrapolation	CPRD		Somerset CCG data
2008/09	303,900	303,900	303,900		244,567	
2009/10	310,795	314,585	308,155		253,486	
2010/11	301,197	327,159	315,550	398,503	257,044	
2011/12	315,127	338,435	323,439	422,202	262,855	
2012/13	326,863	349,319	328,938	439,184	272,051	246,959
2013/14	326,957	360,838	n/a	446,548	275,750	242,691

Table B10 shows considerable variation in measures of volume of activity. In part this is due to the inclusion / exclusion of the 'other' category and the definition of 'other' across sources. For example, QResearch includes other clinicians such as pharmacists, medical students, dieticians and social workers. Administrative staff are not included. The definition of other activity in the CPRD used by Curry is simply 'other staff', which may or may not include administrative staff. As QResearch indicates a relatively small contribution of around 3.5% of activity by other clinical staff and Curry finds a contribution of around 45%, it is unlikely that they measure the same type of activity.

For this reason, we also construct a table using more comparable data which excludes the setting 'other' and is shown Table B11 below. The Hobbs et al. figures are as they were in Table B1 and the CHE, Deloitte and ONS figures remove the assumed 3.5% of activity that is classified as 'other'. We have also assumed this figure applies to the Somerset data. The 45% of 'other' activity has been removed from Curry.

Table B11: Comparison of numbers of consultation: GP and Nurse consultation total (000s); excl. setting "Other"

Method / Data	CHE - existing	Deloitte	ONS-existing	Curry 2015	Hobbs et al 2016	CHE Somerset data
	Survey (3 months)	Extrapolation	Extrapolation	CPRD		Somerset CCG data
2008/09	287,806	293,247	293,247		244,567	
2009/10	294,335	303,763	297,352		253,486	
2010/11	285,246	316,107	304,489	232,153	257,044	
2011/12	298,438	327,199	312,101	239,513	262,855	
2012/13	309,553	337,914	317,407	246,071	272,051	246,959
2013/14	309,642	349,245	n/a	245,089	275,750	242,691

As can be seen there is a wide range in the estimates of volume of consultation rates in 2013/14, ranging from approximately 245 million consultations to 349 million consultations, with an average estimate of 284 million GP and Nurse Consultations. The Deloitte estimate appears to be the main outlier with an estimate of over 60 million more consultations than the average. That this is the highest estimate is primarily a function of an assumed ever increasing rate of consultations per person. Not a single measure which uses contemporary data (CPRD, Somerset or survey-based) supports this assumption and as such, all other measures produce figures which are significantly below the much published Deloitte figure. At the other extreme, the Somerset data not only indicate the lowest estimate of volume, but also a decrease since the previous year.

Comparison of approaches in calculating growth rates

Whilst the estimates of the volume of primary care activity are themselves interesting, the main objective of the report is to examine the extent to which they affect measures of productivity growth. Estimates may show different amounts of consultations but similar patterns of changes over time. It should be noted though, that estimates of greater volume will inflate the contribution that primary care growth makes to the overall NHS productivity measure.

Table B12 shows the implied Laspeyres growth rates using cost data from Table 28 and a distribution of types of consultations based on Table 27 and applied to the correct levels of aggregation in the published data from the various sources. Growth rates excluding 'other' consultations are reported in Table B13.

As can be seen there are still substantive differences across measures with the Deloitte and Somerset measures representing the two extremes. There is a surprising difference between the two CPRD based measures.

Table B12: Estimated growth rates in GP activity, including setting "Other"

Method / Data	CHE	Deloitte	ONS-existing	Curry 2015	Hobbs et al 2016	CHE Somerset data
	Survey (3 months)	Extrapolation	Extrapolation	CPRD	CPRD	Somerset CCG data
2007/08-2008/09			4.80%			
2008/09-2009/10		3.52%	1.40%		3.01%	
2009/10-2010/11	-3.09%	4.00%	2.40%		2.02%	
2010/11-2011/12	4.62%	3.45%	2.50%	5.24%	1.38%	
2011/12-2012/13	3.72%	3.22%	1.70%	3.77%	3.41%	
2012/13-2013/14	0.03%	3.30%	n/a	1.57%	0.92%	-1.66%

Table B13: Estimated growth rates in GP activity, excluding setting "Other"

Method / Data	CHE	Deloitte	ONS-existing	Curry 2015	Hobbs et al 2016	CHE Somerset data
	Survey (3 months)	Extrapolation	Extrapolation	CPRD	CPRD	Somerset CCG data
2008/09-2009/10	2.27%	3.52%	1.40%		3.01%	
2009/10-2010/11	-3.09%	4.00%	2.40%		2.02%	
2010/11-2011/12	4.62%	3.45%	2.50%	5.36%	1.38%	
2011/12-2012/13	3.72%	3.22%	1.70%	3.64%	3.41%	
2012/13-2013/14	0.03%	3.30%		0.94%	0.92%	-1.73%

B.6 Conclusions

Our primary interest is in estimating the volume of primary care activity, but there are currently no comprehensive complete data sets of primary care activity in England. In the absence of data, there are essentially three potential means of imperfectly addressing the issue.

1. Use a large sample of data extracted from GP computer systems, such as QResearch, CPRD, THIN, ResearchOne or other data collection such as Somerset CCG. These are unlikely to be representative of the population of practices or patients.

2. Use data from national surveys which contain some (hopefully time-invariant) questions on primary care use. These suffer the disadvantages that questions are rarely asked directly about the volume of consultations, that answers may be inaccurate, and that those surveyed may not be representative of the population.

3. Extrapolate future predictions of use based on a historical time series, but as these are based on either survey or sample data. We see this as the least satisfactory option.

To some extent, we are fortunate that there exist a number of published analyses using different combinations of methods and sources. Although the detail may be lacking in what is publically available, the data do permit simple comparisons of the main aspect of interest – the measure of activity growth.

The comparison of methods generally shows that, unsurprisingly, using different sources yields different estimates of primary care activity. It also highlights an anomaly in that what seems to be essentially the same method (extrapolation of linear trend) on the same data yields very different results (Deloitte versus ONS existing and Hobbs et al versus Curry).

With no gold standard against which to compare measures, it is difficult to draw definitive conclusions from the analysis. However, that is not to say that we regard all methods as being equally likely to produce reliable measures of activity. Our largely pragmatic conclusions are:

- Measurement should be based on some actual measurement of contemporary data which pertains to measure activity in the period under analysis, i.e. extrapolation of historical time-series data is not desirable.

- Measurement based on actual observed activity should be preferred to stated activity, i.e. we prefer sampled observational data to survey data. This is conditional on the perceived quality/representativeness of the data which may in itself be difficult to measure, though there may be occasions when this is obvious (e.g. CPRD data).

- Given the uncertainty, primary care should be subject to greater sensitivity analysis than is currently conducted. A base case should be selected on the basis of perceived quality of available data – this may not remain constant over time. Alternative measures using other sample or survey data should be considered in the sensitivity analysis.

- Survey data give every indication of improving in the near future with large scale surveys using questions which are more directly related to the measurement of activity. With such measures it may be possible to assign confidence intervals to the measure and/or synthesise evidence. When using survey data, population adjustment is necessary.

Given these preferences, there is no clear 'best' estimate of primary care activity. Our proposed solution is, therefore, a pragmatic one as there is no standard best source and our ability to measure genuine activity may vary substantially year to year. As a result, researchers should consider each year which are the best measures to use. It may be advisable to continue to use the GP Patient Survey as long as it remains in this form as a means of producing a consistent measure over time, but there may be occasions when there are better data available and the base case measure may change over each paired year comparison.