

ESTIMATING EXPECTED HEALTH OPPORTUNITY COSTS IN THE NHS

(Analysis of 2003/04 Expenditure Data)

YORK TEAM

Contents:

• Summary of Appendix 1	2
○ Table 1 Outcome and expenditure elasticities for 2003/04, 2004/05, 2005/06, 2006/07, 2007/08, 2008/09 and 2009/10	6
• Summary of Appendix 2	7
○ Table 2 Probabilistic results for 2003/04 compared to previously generated results	8
○ Figure 1 Results illustrating uncertainty for 2003/04 and previously generated results – cost per QALY	10
○ Figure 2 Results illustrating uncertainty for 2003/04 and previously generated results – Health opportunity costs of £10mn (QALYs)	10
○ Table 3 Sensitivity of results to estimated outcome elasticities	12
○ Table 4 Sensitivity of overall results to estimated spend elasticities	13
○ Table 5 Sensitivity of overall results to surrogacy and extrapolation assumptions	15
• Appendix 1 Outline of data update, estimation strategy, and results for outcome and expenditure models for 2003/04	16
○ Table A1 Outcome and expenditure elasticities for 2003/04, 2004/05, 2005/06, 2006/07, 2007/08, 2008/09 and 2009/10	20
○ Table A2 Nature of failure of previous year’s specification when applied to the following year’s data	26
○ Table A3 OLS specification for previous years and current year	27
○ Table A4 Preferred outcome specifications for 2003/04	28
○ Table A5 Preferred expenditure specifications for 2003/04	30
○ Table A6 Estimation path to preferred outcome specifications for 2003/04	35
○ Table A7 Estimation path to preferred expenditure specifications for 2003/04	38
• Appendix 2 Expected health opportunity costs in the NHS (2003/04 results)	45
• Appendix 2.1 Results	45
○ Table A8 Deterministic results for 2003/04 compared to previously generated results	45
○ Table A9 Probabilistic results for 2003/04 compared to previously generated results	46
○ Figure A1 Results illustrating uncertainty for 2003/04 and previously generated results – cost per QALY	48
○ Figure A2 Results illustrating uncertainty for 2003/04 and previously generated results – Health opportunity costs of £10mn (QALYs)	48
○ Table A10 Implied PBC cost per QALY ratios over time	50
• Appendix 2.2 Sensitivity analysis	51
○ Table A11 Sensitivity of results to estimated outcome elasticities	52
○ Table A12 Sensitivity of overall results to estimated spend elasticities	53
○ Table A13 Sensitivity of overall results to surrogacy and extrapolation assumptions	56
• Appendix 2.3 Outline of ONS data update for 2003/04	57
○ Table A14 Net YLL for 2003-2005, 2004-2006, 2005-2007, 2006-2008, 2007-2009, 2008-2010 and 2009-2011 using LE for each PBC	58
• Appendix 2.4 Comparison with overall NHS mortality elasticities	62
○ Table A15 Estimated overall elasticities	62

Summary

This document comprises of two appendices:

Summary of Appendix 1: Outline of data update, estimation strategy, and results for outcome and expenditure models for 2003/04

Starting point: the 2004/05 specification

1. Identify the preferred specification for the outcome and expenditure equation for each programme budget category (PBC) for 2004/05. The outcome and expenditure elasticities generated by these specifications (when estimated at LA-level) are shown in Table 1.

Re-estimate the 2004/05 specifications using updated data

2. The 2004/05 specifications were derived using a combination PCT-level data mapped to LA-level and direct LA-level data. Backdate PCT-level data to 2003/04 and put backdated PCT-level data through the appropriate mapper to obtain LA-level data. This will include backdating and mapping:

- the PB expenditure data from 2004/05 to 2003/04
- the raw population, unified weighted population, and MFF estimates used and implied by the resource allocations for 2003/04
- PB specific indices of need (eg infectious diseases, mental health, maternity) from the relevant DH resource allocation exposition books (where possible)
- PB specific disease prevalence rates as extracted from the HSCIC's QOF database (where possible).

Note that the PB data for 2003/04 was originally generated for the then 303 PCTs. This has been converted to the new 152 (since October 2006) PCT boundaries by the DH.

3. Obtain LA-level statistics for those variables that are reported at this unit of analysis. This will involve backdating LA-level data for 2004/05 to 2003/04. This will include backdating :

- mortality data for 2004/05/06 with data for 2003/04/05
- census-based variables for 2004 with data for 2003 (by appropriate interpolation between 2001 and 2011).

Complications: (i) no data for CKD prevalence for 2003/4, 2004/5, 2005/6 and 2006/7 so we use 2007/8 as a proxy for all four years; (ii) prevalence rates for diabetes and epilepsy for 2003/4 and 2004/5 are available by PCT but these rates are for the set of PCTs (n=303) prior to the re-organisation in October 2006. Without a mapper for this re-organisation, we use the prevalence rates for 2006/7 as proxies for the rates in 2003/4; (iii) a similar issue affects the IMD2007 and we have persevered with this here rather than investigating the IMD2004 (remember the IMD2004 uses data from 1997 to 2003); (iv) there were some relatively small boundary changes for local government in April 2009. We persevere with this (post-2009) geography by adjusting the reported pre-April 2009 mortality rates so that they relate to the post-2009 boundaries as closely as possible.

More precisely, the re-organisation of local government created nine new unitary authorities (UAs). Five of these were created from existing county councils and their district councils. The remaining four new UAs were created by splitting Cheshire and Bedfordshire into two each along existing district council boundaries. The nine unitary authorities are, therefore, all aggregates of existing local authorities. Further details of the re-organisation are shown below:

- Bedford UA was formed from Bedford District Council.
- Central Bedfordshire UA was formed from Mid Beds and South Beds District Councils.
- Cheshire East UA was formed from Congleton, Crewe & Nantwich and Macclesfield District Councils.
- Cheshire West and Chester UA was formed from Chester, Ellesmere Port and Vale Royal District Councils.
- Cornwall UA was formed from the Caradon, Carrick, Kerrier, North Cornwall, Penwith and Restormel District Councils (i.e., equals Cornwall county council except the Isles of Scilly).
- County Durham UA was formed from Chester-le-Street, Derwentside, Durham, Easington, Sedgefield, Teesdale and Wear Valley District Councils (i.e., Durham county council).
- Northumberland UA was formed from Alnwick, Berwick-upon-Tweed, Blyth Valley, Castle Morpeth, Tynedale and Wansbeck District Councils (i.e., Northumberland county council).
- Shropshire UA was formed from Bridgnorth, North Shropshire, Oswestry, Shrewsbury and South Shropshire District Councils (i.e., Shropshire county council).
- Wiltshire UA was formed from Kennet, North Wiltshire, Salisbury and West Wiltshire District Councils (i.e., Wiltshire county council).

The transition of Bedford from a district council (DC) to a UA poses no problems for us as mortality data for all district councils are routinely reported by the HSCIC. Thus we can backdate our UA-level data using DC data.

There is an issue with Bedfordshire UA and the two Cheshire UAs. How do we combine the mortality rates for the two or three component DCs to reflect the post-2009 UA boundaries? Population estimates for these DCs are readily available for 2000 (latest available from the NOMIS website) so we used these as weights so that we could combine the DC mortality rates to form the estimated UA mortality rates. Ideally, of course, we would use mortality and population data by age group and year for each of these DCs for each of the study periods to form the relevant UA data. But this would be a considerable undertaking (even if we could get the data) and it is not obvious that such an exercise would involve a sensible use of project resources (not least because only three UAs are affected).

Finally, there is a very slight discontinuity with the Cornwall data. We use the Cornwall county council mortality data for pre-2009 as a proxy for Cornwall UA data. The difference here is that the

UA (population in 2000 is 495,400) excludes the Isles of Scilly (population 2,100) but the County Council includes it.

Estimation strategy for 2003/04: same as for 2004/05

4. Having backdated all data, use the preferred specification for 2004/05 to re-estimate each outcome and expenditure equation for 2003/04.
5. If this re-estimation produces a result which (a) passes the appropriate statistical tests and (b) generates coefficients in line with theoretical priors, use this result as our preferred result for 2003/04. This rule is applied to cases where the preferred specification for 2004/05 is either IV or OLS. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table 1 has a '--' in the next column.
6. If the re-estimation produces a result which does not pass tests/have coefficients in line with priors, re-estimate the equation having adjusted the specification as suggested by the initial result. So, for example, if the initial estimation implies the presence of weak instruments and one of the instruments is insignificant in the first-stage regression, try re-estimating the equation without the insignificant instrument. And if, for example, one of the regressors in the second-stage regression is insignificant, try re-estimating without it. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table 1 has an 'A' in the next column.
7. If a relatively minor adjustment to the 2004/05 specification does not generate a statistically and theoretically acceptable result, re-derive the IV equation to be estimated (again, this applies to cases where the preferred specification for 2004/05 is either IV or OLS). That is, use OLS with backward stepwise regression to identify relevant covariates to be included in the second-stage regression having forced in the relevant variables throughout. For the outcome equation we force in own programme expenditure, and for the expenditure equation the other programme need variable and the total budget term are forced in throughout the stepwise procedure.
8. Having identified relevant covariates for the second-stage regression, again use stepwise backward regression to identify relevant instruments for the first-stage conditioning on the covariates for the second-stage identified above. In other words, these second-stage covariates are forced in throughout stepwise procedure to identify relevant instruments.
9. Having identified covariates for the second-stage (in 7 above) and instruments for the first-stage (in 8 above), re-estimate the IV specification equation using these two sets of variables. If the endogeneity test suggests that a variable (eg own programme expenditure in the outcome equation) is clearly not endogenous then re-estimate using OLS. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table 1 has a 'B' in the next column.
10. If the above re-estimation approach produces a result which does not pass tests/have coefficients in line with priors, re-estimate the equation having adjusted the specification as suggested by the initial result (for example, if the result fails the misspecification test try adding the squared value of one of the regressors to the specification). If this re-estimation produces an acceptable result, the resulting elasticity shown in Table 1 has a 'C' in the next column.

11. If all of the above approaches fail to produce an acceptable result, consider excluding PCTs with extreme values of expenditure per person. Only explore this option for programmes with small amounts of expenditure and/or mortality. If this re-estimation approach produces an acceptable result, the resulting elasticity shown in Table 1 has a 'D' in the next column.

Results for 2003/04: elasticities from preferred specifications

12. The estimation strategy outlined above generated the outcome and expenditure elasticities for 2003/04 shown in Table 1.

Results for 2003/04: full IV/OLS result for preferred specifications

13. The full result [IV (second-stage) or OLS] associated with each elasticity reported in Table 1 can be found in Table A3 (for the outcome equations) and Table A4 (for the expenditure equations) in the appendix.

Results for 2003/04: estimation path to preferred specifications

14. The full estimation path for each result (starting with the re-estimation of the 2004/05 specification with updated data) can be found in Table A5 (for the outcome equations) and Table A6 (for the expenditure equations) in the appendix.

Table 1 Outcome and expenditure elasticities for 2003/04, 2004/05, 2005/06, 2006/07, 2007/08, 2008/09 and 2009/10

PBC #	PBC description	for 2009/10				for 2008/09				for 2007/08				for 2006/07				for 2005/06				for 2004/05				for 2003/04			
		Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth				
1	Infectious diseases	-0.310*	A	0.968***	--	-0.549***	A	1.477**	--	-0.660**	A	1.387***	--	-0.608	A	1.057***	A	-0.432	--	1.205***	--	-0.100	A	0.932***	A	-0.205	A	1.094***	A
2	Cancers and tumours	-0.345***	--	0.502**	A	-0.287***	--	0.784**	--	-0.273***	--	1.626***	A	-0.239***	A	1.219***	--	-0.169*	A	1.592***	A	-0.224**	--	1.259***	--	-0.207**	--	1.717***	A
3	Diseases of the blood	n/a		1.060***	B	n/a		0.995***	--	n/a		1.374***	--	n/a		1.037***	--	n/a		1.486***	--	n/a		0.952***	A	n/a		0.652*	B
4	Endocrine, nutritional, metabolic	-1075**	A	0.708***	--	-1607**	--	0.498***	A	-1.491	D	0.455***	--	-1.464	A	0.630***	A	-1035	--	0.663***	--	-1843	A	0.573***	A	See text	n/a	0.653***	A
5	Mental health disorders	n/a		0.899***	--	n/a		0.995***	--	n/a		1.103***	--	n/a		1.143***	--	n/a		0.997***	--	n/a		0.999***	--	n/a		1.333***	--
6	Learning disability	n/a		0.647**	B	n/a		0.329	--	n/a		0.386	--	n/a		0.410	B	n/a		0.449*	D	n/a		0.446*	--	n/a		0.646*	A
7	Neurological problems	-1357	C	0.850***	--	-0.304	C	0.897***	--	-0.237*	B	0.733***	A	-0.869*	D	0.382*	A	-0.325	A	1.220***	--	-0.968**	A	0.929***	--	-0.757*	A	1.408***	--
8	Vision problems	n/a		0.934***	A	n/a		0.707**	--	n/a		1.106***	C	n/a		0.937**	--	n/a		1.127***	--	n/a		1.350***	--	n/a		0.833***	--
9	Hearing problems	n/a		1.273***	C	n/a		1.637***	--	n/a		0.957*	A	n/a		0.989**	--	n/a		0.762**	--	n/a		0.526	C	n/a		0.694*	A
10	Circulatory problems	-1842***	--	0.494*	--	-1384***	--	1.784***	A	-1315***	A	1.614***	--	-1.404***	--	1.578***	--	-1.637***	A	1.477***	--	-1.375***	A	1.652***	--	-1.202***	--	1.873***	--
11	Respiratory problems	-2.103***	B	0.576***	--	-1.677***	--	0.752**	--	-1.564***	A	1.555***	A	-2.287***	--	1.287***	--	-2.217***	A	1.225***	A	-2.494***	A	1.253***	--	-1.666***	--	1.667***	--
12	Dental problems	n/a		0.765***	B	n/a		0.428**	B	n/a		0.420***	D	n/a		0.835**	C	n/a		See text	n/a	n/a		See text	n/a	n/a		0.717*	A
13	Gastro-intestinal problems	-1989*	A	0.387*	--	-1.146**	A	0.520*	--	-0.837**	--	1.490***	A	-1.255**	--	1.014***	A	-1.014*	--	1.076***	--	-1.253***	--	0.928***	--	-1.493***	A	1.409***	--
14	Skin problems	n/a		0.890***	D	n/a		0.907***	--	n/a		0.787***	--	n/a		0.707***	A	n/a		0.840***	A	n/a		0.595***	A	n/a		0.700***	--
15	Musculo-skeletal problems	n/a		0.295	B	n/a		0.738***	C	n/a		0.733***	--	n/a		0.628*	A	n/a		0.935***	--	n/a		0.567***	--	n/a		1.014***	--
16	Trauma and injuries	0	n/a	1.090***	--	0	n/a	1.344***	--	-0.638	n/a	1.328***	--	0	n/a	0.705***	--	Tbc		0.897***	A	Tbc		0.576**	A	Tbc		0.556***	A
17	Genito-urinary problems	-2.997	B	0.878***	--	-0.024	C	0.733***	--	-1.977	C	1.015***	A	-0.588	D	0.988***	A	-0.869*	A	1.079***	--	-0.937*	--	0.716***	A	-0.063	B	0.934***	A
18	Maternity and reproductive health	-0.166*	B	0.653***	--	-0.030	A	0.963***	--	-0.057	--	0.563**	--	-0.085	C	0.614**	--	-0.056	B	0.865***	--	-0.121	--	0.678***	A	Tbc		0.757***	A
19	Neonates																												
20	Poisoning and adverse events	n/a		0.658**	--	n/a		2.102***	--	n/a		1.674***	A	n/a		1.107***	--	n/a		1.735***	--	n/a		1.674***	--	n/a		2.327***	--
21	Healthy individuals	n/a		1.246**	--	n/a		1.049	--	n/a		1.296**	C	n/a		0.709	B	n/a		0.507	B	n/a		0.709*	A	n/a		1.538**	A
22	Social care needs	n/a		0.844	B	n/a		1.192*	--	n/a		1.669**	C	n/a		1.702***	--	n/a		1.069*	--	n/a		1.313**	--	n/a		1.587***	A
23	Other (includes GMS/PMS)	n/a		0.564***	B	n/a		0.338***	--	n/a		0.553***	--	n/a		0.447***	A	n/a		0.532***	--	n/a		0.337***	--	n/a		0.687***	A

Notes: (i) see pp3-4 of text for the meaning of the symbols in 're-estimation' columns;

(ii) the 're-estimation' columns for 2009/10 refer to a comparison of the preferred specification for 2009/10 at LA level with the preferred specification for 2008/09 at PCT level.

Summary of Appendix 2: Expected health opportunity costs in the NHS (2003/04 results)

Overview

15. In the second appendix results are presented that reflect the available data for 2003/04 expenditure (this forms Appendix 2.1). In Appendix 2.2, the results are also analysed in terms of how sensitive the results are to two key inputs: i) each of the estimated elasticities and ii) assumptions made in order to overcome data limitations for each PBC (only have mortality outcome data and for only a portion of PBCs). Finally, Appendix 2.3 briefly considers an update regarding data from ONS used to inform burden of disease.

Results

16. Results are presented in two ways as the point estimate of the cost per QALY of marginal activity in the NHS, or alternatively expressed as the expected QALY health opportunity cost for £10,000,000 expenditure.

Table 2 Probabilistic results for 2003/04 compared to previously generated results

2003/04	Point estimate (deterministic)	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£6,381	£6,381	£5,048	£8,534
Health opportunity costs of £10mn (QALYs)	1,567	1,567	1,172	1,981
2004/05	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£5,389	£5,377	£4,110	£7,517
Health opportunity costs of £10mn (QALYs)	1,856	1,860	1,330	2,433
2005/06	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£7,613	£7,635	£5,611	£11,619
Health opportunity costs of £10mn (QALYs)	1,314	1,310	861	1,782
2006/07	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£6,844	£6,838	£5,139	£9,878
Health opportunity costs of £10mn (QALYs)	1,461	1,462	1,012	1,946
2007/08	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£9,747	£9,765	£7,689	£13,043
Health opportunity costs of £10mn (QALYs)	1,026	1,024	767	1,301
2008/09	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£12,960	£13,271	£8,390	£32,881
Health opportunity costs of £10mn (QALYs)	772	754	304	1,192
2009/10	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£9,887	£9,920	£6,802	£17,296
Health opportunity costs of £10mn (QALYs)	1,011	1,008	578	1,470

It can be seen from Table 2 that the expected health opportunity costs of a change in expenditure have decreased slightly between 2004/05 and 2003/04 and so the cost per QALY ratio has risen, which probably results from the additional PBCs in which no outcome elasticity could be reasonably estimated (PBCs 4 and 18+19). In this table, the uncertainty associated with these estimates is shown and it can be judged to what extent any changes in the point estimate between years should

be interpreted as a signal of any trend. From Table 2 it is hard to conclude that there is a significant change in the health opportunity costs of £10mn expenditure, since there is a great deal of overlap between the 90% confidence intervals of the years shown.

Figure 1 Results illustrating uncertainty for 2003/04 and previously generated results – cost per QALY

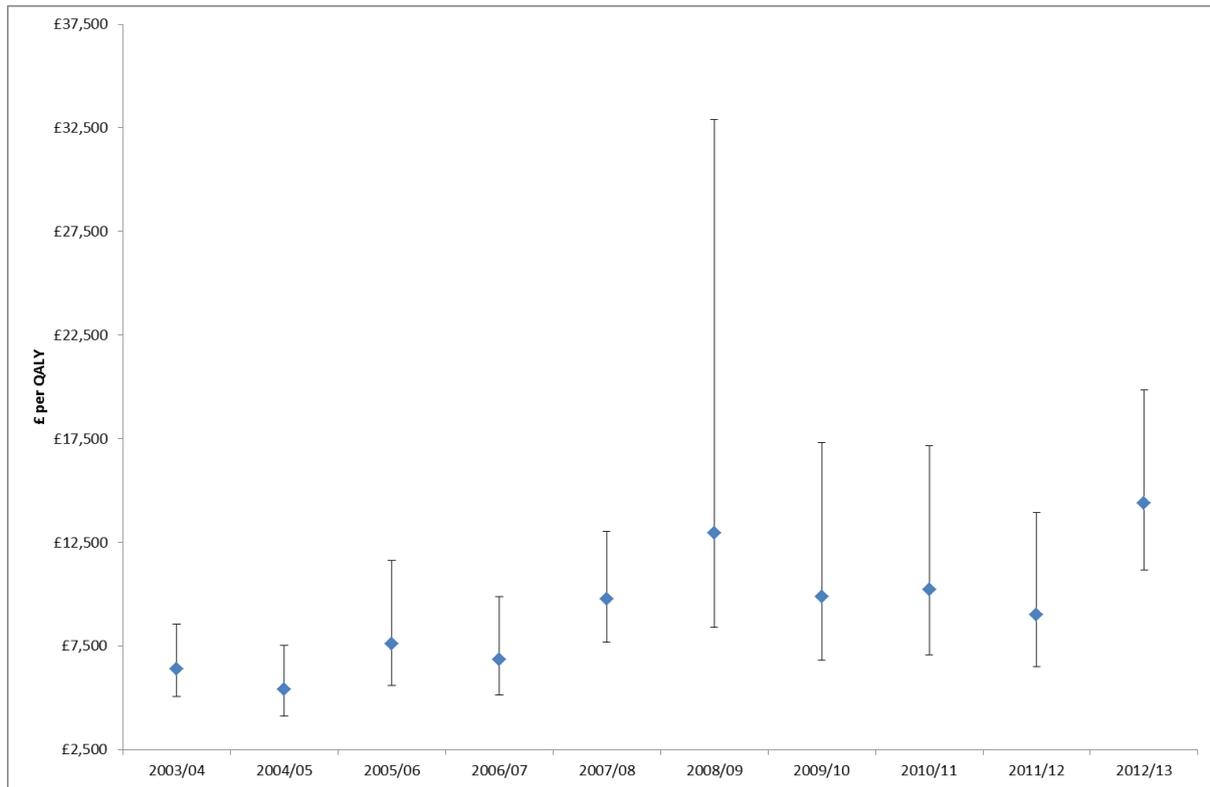
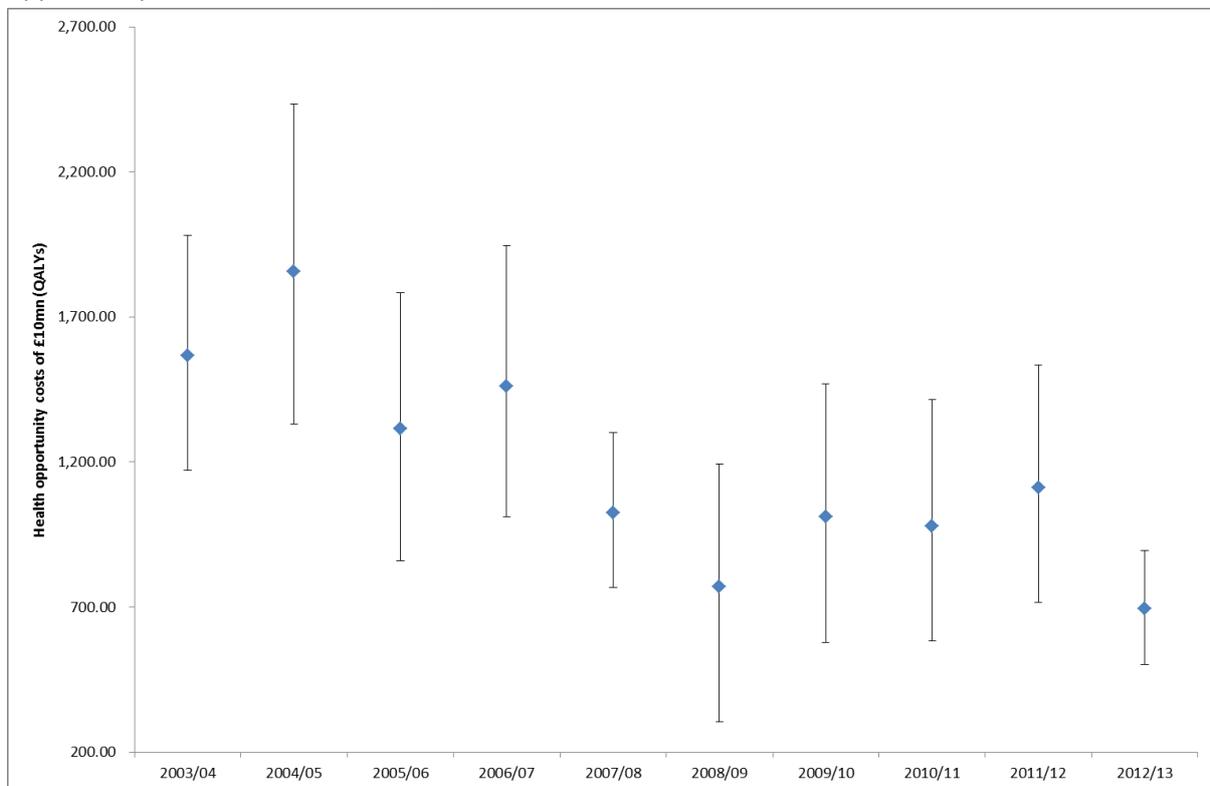


Figure 2 Results illustrating uncertainty for 2003/04 and previously generated results – Health opportunity costs of £10mn (QALYs)



17. It can also be seen from Figures 1 and 2 that while the confidence interval is far from symmetrically distributed around the point estimate of the cost per QALY ratio in Figure 1 (where uncertainty is reflected in the denominator), when expressed as health opportunity costs per £10mn then the distribution of uncertainty is much more symmetric in Figure 2 (uncertainty is reflected in the numerator).

Sensitivity analysis

18. Appendix 2.2 details three sensitivity analyses that were performed. The first two concerned the elasticities that were econometrically estimated for each of the PBCs. In the first case each of the estimated PBC outcome elasticities are varied by +/- 1 standard error. Then, the difference between the two resulting opportunity costs is presented. When this is larger, this implies that the overall resulting estimate of health opportunity costs is more sensitive to the outcome elasticity under consideration. The same procedure is then carried out for each of the PBC expenditure elasticities. The results of these sensitivity analyses are reported in Tables 3 and 4, with analysis and interpretation found in Appendix 2.2.

Table 3 Sensitivity of results to estimated outcome elasticities

	Change in spend	Change in QALY death + QALY alive	Implied PBC cost per QALY (£)	Difference in health opportunity costs between +1 SE and -1 SE in PBC outcome elasticity	% difference in health opportunity costs between +1 SE and -1 SE in PBC outcome elasticity	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2 Cancer	£ 911,210.15	52	£ 17,553.77	68	4.32%	5	6	6	6	5	6
10 Circulatory	£ 1,690,998.53	309	£ 5,479.44	150	9.56%	3	3	3	2	3	4
11 Respiratory	£ 743,564.59	519	£ 1,433.26	324	20.65%	1	1	1	1	1	2
13 Gastro-intestinal	£ 734,239.81	133	£ 5,507.38	89	5.66%	4	5	5	4	4	5
1 Infectious diseases	£ 161,048.46	4	£ 40,054.96	15	0.97%	6	8	7	7	8	7
4 Endocrine	£ 155,074.55	0	N/A	-	-	-	4	4	3	2	3
7 Neurological	£ 344,372.07	228	£ 1,513.13	266	16.97%	2	2	2	5	6	1
17 Genito-urinary	£ 423,602.76	0	£ 993,371.49	14	0.91%	7	7	8	8	7	8
16 Trauma & injuries*	£ 284,061.56	0	N/A	-	-	-	-	-	-	-	-
18+19 Maternity & neonates*	£ 397,234.35	0	N/A	-	-	-	9	9	9	9	9
3 Disorders of Blood	£ 75,278.14	18	£ 4,087.18	-	-	-	-	-	-	-	-
5 Mental Health	£ 1,457,006.85	186	£ 7,846.43	-	-	-	-	-	-	-	-
6 Learning Disability	£ 200,877.21	3	£ 60,828.25	-	-	-	-	-	-	-	-
8 Problems of Vision	£ 168,084.71	8	£ 20,530.56	-	-	-	-	-	-	-	-
9 Problems of Hearing	£ 32,613.89	12	£ 2,637.35	-	-	-	-	-	-	-	-
12 Dental problems	£ 63,364.79	14	£ 4,402.41	-	-	-	-	-	-	-	-
14 Skin	£ 120,429.35	3	£ 39,351.03	-	-	-	-	-	-	-	-
15 Musculo skeletal	£ 510,126.85	71	£ 7,226.20	-	-	-	-	-	-	-	-
20 Poisoning and AE	£ 184,707.54	5	£ 36,041.07	-	-	-	-	-	-	-	-
21 Healthy Individuals	£ 255,882.47	1	£ 179,538.76	-	-	-	-	-	-	-	-
22 Social Care Needs	£ 321,633.83	0	N/A	-	-	-	-	-	-	-	-
23 Other	£ 764,587.55	0	N/A	-	-	-	-	-	-	-	-

Total: 1,567

Table 4 Sensitivity of overall results to estimated spend elasticities

	Change in spend	Change in QALY death + QALY alive	Implied PBC cost per QALY (£)	Difference in health opportunity costs between +1 SE and -1 SE in PBC spend elasticity	% difference in health opportunity costs between +1 SE and -1 SE in PBC spend elasticity	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2 Cancer	£ 911,210.15	52	£ 17,553.77	42	2.65%	6	4	4	8	8	11
10 Circulatory	£ 1,690,998.53	309	£ 5,479.44	42	2.68%	5	12	2	9	2	2
11 Respiratory	£ 743,564.59	519	£ 1,433.26	117	7.45%	1	1	1	1	1	1
13 Gastro-intestinal	£ 734,239.81	133	£ 5,507.38	0	0.01%	22	14	12	18	12	13
1 Infectious diseases	£ 161,048.46	4	£ 40,054.96	14	0.88%	12	16	14	19	21	19
4 Endocrine	£ 155,074.55	0	N/A	11	0.73%	14	10	11	12	10	3
7 Neurological	£ 344,372.07	228	£ 1,513.13	47	3.00%	4	3	19	6	19	18
17 Genito-urinary	£ 423,602.76	0	£ 993,371.49	37	2.35%	7	5	5	4	11	6
16 Trauma & injuries*	£ 284,061.56	0	N/A	34	2.14%	8	2	3	7	6	8
18+19 Maternity & neonates*	£ 397,234.35	0	N/A	53	3.36%	2	8	7	2	5	4
3 Disorders of Blood	£ 75,278.14	18	£ 4,087.18	8	0.49%	18	21	15	20	18	22
5 Mental Health	£ 1,457,006.85	186	£ 7,846.43	10	0.66%	15	15	20	15	20	12
6 Learning Disability	£ 200,877.21	3	£ 60,828.25	29	1.84%	11	9	9	5	7	10
8 Problems of Vision	£ 168,084.71	8	£ 20,530.56	12	0.77%	13	13	13	16	15	17
9 Problems of Hearing	£ 32,613.89	12	£ 2,637.35	9	0.54%	16	18	17	17	13	20
12 Dental problems	£ 63,364.79	14	£ 4,402.41	5	0.31%	20	22	21	11	14	14
14 Skin	£ 120,429.35	3	£ 39,351.03	6	0.37%	19	17	16	14	16	16
15 Musculo skeletal	£ 510,126.85	71	£ 7,226.20	3	0.21%	21	20	22	22	22	21
20 Poisoning and AE	£ 184,707.54	5	£ 36,041.07	8	0.54%	17	19	18	21	17	15
21 Healthy Individuals	£ 255,882.47	1	£ 179,538.76	30	1.94%	10	11	10	13	9	5
22 Social Care Needs	£ 321,633.83	0	N/A	33	2.09%	9	6	6	10	3	7
23 Other	£ 764,587.55	0	N/A	51	3.23%	3	7	8	3	4	9

Total: 1,567

19. Following these two sensitivity analyses, a third is performed with a different emphasis, which analyses the sensitivity of the overall health opportunity cost estimate to two key assumptions:

Surrogacy- we are required to make an assumption about how the effect on mortality for PBCs with a mortality indicator can be used as a *surrogate* for the effect that expenditure has on morbidity (or health-related quality of life) in those PBCs.

Extrapolation- We are required to make an assumption about how the estimated effects on mortality found for PBCs with a mortality indicator can be *extrapolated* to the effect that expenditure has on mortality for those PBCs that do not have a mortality indicator.

In order to assess the impact of these assumptions on the overall results for the NHS, we evaluate the health effects of £10mn spending at the margin in the NHS when either:

- a) For PBCs with a mortality indicator: no surrogacy assumption, therefore expenditure has no effect on morbidity
- b) For PBCs without a mortality indicator: assume no health effects at all, neither on mortality (extrapolation assumption) nor morbidity (surrogacy assumption)

The results are found here in Table 5. Interpretation and analysis is found in Appendix 2.2.

Table 5 Sensitivity of overall results to surrogacy and extrapolation assumptions

		Change in spend	Change in QALY death	Change in QALY alive	Health opportunity costs sensitivity to mortality/morbidity assumption (%)	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2	Cancer	£ 911,210.15	48	4	-0.25%	12	15	16	15	14	14
10	Circulatory	£ 1,690,998.53	207	102	-6.48%	4	5	3	4	3	5
11	Respiratory	£ 743,564.59	6	513	-32.71%	1	1	1	1	1	1
13	Gastro-intestinal	£ 734,239.81	46	87	-5.56%	5	7	7	6	5	6
1	Infectious diseases	£ 161,048.46	1	3	-0.20%	14	17	12	11	10	10
4	Endocrine	£ 155,074.55	0	0	0.00%	-	4	6	3	4	4
7	Neurological	£ 344,372.07	10	218	-13.88%	2	2	4	5	7	3
17	Genito-urinary	£ 423,602.76	0	0	-0.02%	17	13	13	13	11	18
16	Trauma & injuries*	£ 284,061.56	0	0	0.00%	-	-	-	-	-	-
18+19	Maternity & neonates*	£ 397,234.35	0	0	0.00%	-	19	19	19	19	19
3	Disorders of Blood	£ 75,278.14	1	17	-1.18%	7	8	8	8	8	9
5	Mental Health	£ 1,457,006.85	16	169	-11.85%	3	3	2	2	2	2
6	Learning Disability	£ 200,877.21	1	3	-0.21%	13	16	17	17	17	15
8	Problems of Vision	£ 168,084.71	0	8	-0.52%	10	10	11	12	12	12
9	Problems of Hearing	£ 32,613.89	0	12	-0.79%	9	11	10	9	9	8
12	Dental problems	£ 63,364.79	0	14	-0.92%	8	9	9	10	13	11
14	Skin	£ 120,429.35	1	2	-0.20%	15	14	15	14	16	13
15	Musculo skeletal	£ 510,126.85	4	67	-4.50%	6	6	5	7	6	7
20	Poisoning and AE	£ 184,707.54	1	4	-0.33%	11	12	14	16	15	16
21	Healthy Individuals	£ 255,882.47	0	1	-0.09%	16	18	18	18	18	17
22	Social Care Needs	£ 321,633.83	0	0	0.00%	-	-	-	-	-	-
23	Other	£ 764,587.55	0	0	0.00%	-	-	-	-	-	-
Total:			342	1,225							
Total change in QALY death + QALY alive				1,567							

Appendix 1: Outline of data update, estimation strategy, and results for outcome and expenditure models for 2003/04

Starting point: the 2004/05 specification

20. Identify the preferred specification for the outcome and expenditure equation for each programme budget category (PBC) for 2004/05. The outcome and expenditure elasticities generated by these specifications (when estimated at LA-level) are shown in Table A1.

Re-estimate the 2004/05 specifications using updated data

21. The 2004/05 specifications were derived using a combination PCT-level data mapped to LA-level and direct LA-level data. Backdate PCT-level data to 2003/04 and put backdated PCT-level data through the appropriate mapper to obtain LA-level data. This will include backdating and mapping:

- the PB expenditure data from 2004/05 to 2003/04
- the raw population, unified weighted population, and MFF estimates used and implied by the resource allocations for 2003/04
- PB specific indices of need (eg infectious diseases, mental health, maternity) from the relevant DH resource allocation exposition books (where possible)
- PB specific disease prevalence rates as extracted from the HSCIC's QOF database (where possible).

Note that the PB data for 2003/04 was originally generated for the then 303 PCTs. This has been converted to the new 152 (since October 2006) PCT boundaries by the DH.

22. Obtain LA-level statistics for those variables that are reported at this unit of analysis. This will involve backdating LA-level data for 2004/05 to 2003/04. This will include backdating :

- mortality data for 2004/05/06 with data for 2003/04/05
- census-based variables for 2004 with data for 2003 (by appropriate interpolation between 2001 and 2011).

Complications: (i) no data for CKD prevalence for 2003/4, 2004/5, 2005/6 and 2006/7 so we use 2007/8 as a proxy for all four years; (ii) prevalence rates for diabetes and epilepsy for 2003/4 and 2004/5 are available by PCT but these rates are for the set of PCTs (n=303) prior to the re-organisation in October 2006. Without a mapper for this re-organisation, we use the prevalence rates for 2006/7 as proxies for the rates in 2003/4; (iii) a similar issue affects the IMD2007 and we have persevered with this here rather than investigating the IMD2004 (remember the IMD2004 uses data from 1997 to 2003); (iv) there were some relatively small boundary changes for local government in April 2009. We persevere with this (post-2009) geography by adjusting the reported pre-April 2009 mortality rates so that they relate to the post-2009 boundaries as closely as possible.

More precisely, the re-organisation of local government created nine new unitary authorities (UAs). Five of these were created from existing county councils and their district councils. The remaining four new UAs were created by splitting Cheshire and Bedfordshire into two each along existing

district council boundaries. The nine unitary authorities are, therefore, all aggregates of existing local authorities. Further details of the re-organisation are shown below:

- Bedford UA was formed from Bedford District Council.
- Central Bedfordshire UA was formed from Mid Beds and South Beds District Councils.
- Cheshire East UA was formed from Congleton, Crewe & Nantwich and Macclesfield District Councils.
- Cheshire West and Chester UA was formed from Chester, Ellesmere Port and Vale Royal District Councils.
- Cornwall UA was formed from the Caradon, Carrick, Kerrier, North Cornwall, Penwith and Restormel District Councils (i.e., equals Cornwall county council except the Isles of Scilly).
- County Durham UA was formed from Chester-le-Street, Derwentside, Durham, Easington, Sedgfield, Teesdale and Wear Valley District Councils (i.e., Durham county council).
- Northumberland UA was formed from Alnwick, Berwick-upon-Tweed, Blyth Valley, Castle Morpeth, Tynedale and Wansbeck District Councils (i.e., Northumberland county council).
- Shropshire UA was formed from Bridgnorth, North Shropshire, Oswestry, Shrewsbury and South Shropshire District Councils (i.e., Shropshire county council).
- Wiltshire UA was formed from Kennet, North Wiltshire, Salisbury and West Wiltshire District Councils (i.e., Wiltshire county council).

The transition of Bedford from a district council (DC) to a UA poses no problems for us as mortality data for all district councils are routinely reported by the HSCIC. Thus we can backdate our UA-level data using DC data.

There is an issue with Bedfordshire UA and the two Cheshire UAs. How do we combine the mortality rates for the two or three component DCs to reflect the post-2009 UA boundaries? Population estimates for these DCs are readily available for 2000 (latest available from the NOMIS website) so we used these as weights so that we could combine the DC mortality rates to form the estimated UA mortality rates. Ideally, of course, we would use mortality and population data by age group and year for each of these DCs for each of the study periods to form the relevant UA data. But this would be a considerable undertaking (even if we could get the data) and it is not obvious that such an exercise would involve a sensible use of project resources (not least because only three UAs are affected).

Finally, there is a very slight discontinuity with the Cornwall data. We use the Cornwall county council mortality data for pre-2009 as a proxy for Cornwall UA data. The difference here is that the UA (population in 2000 is 495,400) excludes the Isles of Scilly (population 2,100) but the County Council includes it.

Estimation strategy for 2003/04: same as for 2004/05

23. Having backdated all data, use the preferred specification for 2004/05 to re-estimate each outcome and expenditure equation for 2003/04.
24. If this re-estimation produces a result which (a) passes the appropriate statistical tests and (b) generates coefficients in line with theoretical priors, use this result as our preferred result for 2003/04. This rule is applied to cases where the preferred specification for 2004/05 is either IV or OLS. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table A1 has a '--' in the next column.
25. If the re-estimation produces a result which does not pass tests/have coefficients in line with priors, re-estimate the equation having adjusted the specification as suggested by the initial result. So, for example, if the initial estimation implies the presence of weak instruments and one of the instruments is insignificant in the first-stage regression, try re-estimating the equation without the insignificant instrument. And if, for example, one of the regressors in the second-stage regression is insignificant, try re-estimating without it. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table A1 has an 'A' in the next column.
26. If a relatively minor adjustment to the 2004/05 specification does not generate a statistically and theoretically acceptable result, re-derive the IV equation to be estimated (again, this applies to cases where the preferred specification for 2004/05 is either IV or OLS). That is, use OLS with backward stepwise regression to identify relevant covariates to be included in the second-stage regression having forced in the relevant variables throughout. For the outcome equation we force in own programme expenditure, and for the expenditure equation the other programme need variable and the total budget term are forced in throughout the stepwise procedure.
27. Having identified relevant covariates for the second-stage regression, again use stepwise backward regression to identify relevant instruments for the first-stage conditioning on the covariates for the second-stage identified above. In other words, these second-stage covariates are forced in throughout stepwise procedure to identify relevant instruments.
28. Having identified covariates for the second-stage (in 7 above) and instruments for the first-stage (in 8 above), re-estimate the IV specification equation using these two sets of variables. If the endogeneity test suggests that a variable (eg own programme expenditure in the outcome equation) is clearly not endogenous then re-estimate using OLS. If this re-estimation produces an acceptable result, the resulting elasticity shown in Table A1 has a 'B' in the next column.
29. If the above re-estimation approach produces a result which does not pass tests/have coefficients in line with priors, re-estimate the equation having adjusted the specification as suggested by the initial result (for example, if the result fails the misspecification test try adding the squared value of one of the regressors to the specification). If this re-estimation produces an acceptable result, the resulting elasticity shown in Table A1 has a 'C' in the next column.
30. If all of the above approaches fail to produce an acceptable result, consider excluding PCTs with extreme values of expenditure per person. Only explore this option for programmes with small amounts of expenditure and/or mortality. If this re-estimation approach produces an acceptable result, the resulting elasticity shown in Table A1 has a 'D' in the next column.

Results for 2003/04: elasticities from preferred specifications

31. The estimation strategy outlined above generated the outcome and expenditure elasticities for 2003/04 shown in Table A1.

Results for 2003/04: full IV/OLS result for preferred specifications

32. The full result [IV (second-stage) or OLS] associated with each elasticity reported in Table A1 can be found in Table A3 (for the outcome equations) and Table A4 (for the expenditure equations) in the appendix.

Results for 2003/04: estimation path to preferred specifications

33. The full estimation path for each result (starting with the re-estimation of the 2004/05 specification with updated data) can be found in Table A5 (for the outcome equations) and Table A6 (for the expenditure equations) in the appendix.

Table A1 Outcome and expenditure elasticities for 2003/04, 2004/05, 2005/06, 2006/07, 2007/08, 2008/09 and 2009/10

PBC #	PBC description	for 2009/10				for 2008/09				for 2007/08				for 2006/07				for 2005/06				for 2004/05				for 2003/04			
		Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth	Outcome elasticity	Re-esth elasticity	Spend elasticity	Re-esth
1	Infectious diseases	-0.310*	A	0.968***	--	-0.549***	A	1.477**	--	-0.660**	A	1.387***	--	-0.608	A	1.057***	A	-0.432	--	1.205***	--	-0.100	A	0.932***	A	-0.205	A	1.094***	A
2	Cancers and tumours	-0.345***	--	0.502**	A	-0.287***	--	0.784**	--	-0.273***	--	1.626***	A	-0.239***	A	1.219***	--	-0.169*	A	1.592***	A	-0.224**	--	1.259***	--	-0.207**	--	1.717***	A
3	Diseases of the blood	n/a		1.060***	B	n/a		0.995***	--	n/a		1.374***	--	n/a		1.037***	--	n/a		1.486***	--	n/a		0.952***	A	n/a		0.652*	B
4	Endocrine, nutritional, metabolic	-1.075**	A	0.708***	--	-1.607**	--	0.498***	A	-1.491	D	0.455***	--	-1.464	A	0.630***	A	-1.035	--	0.663***	--	-1.843	A	0.573***	A	See text	n/a	0.653***	A
5	Mental health disorders	n/a		0.899***	--	n/a		0.995***	--	n/a		1.103***	--	n/a		1.143***	--	n/a		0.997***	--	n/a		0.999***	--	n/a		1.333***	--
6	Learning disability	n/a		0.647**	B	n/a		0.329	--	n/a		0.386	--	n/a		0.410	B	n/a		0.449*	D	n/a		0.446*	--	n/a		0.646*	A
7	Neurological problems	-1.357	C	0.850***	--	-0.304	C	0.897***	--	-0.237*	B	0.733***	A	-0.869*	D	0.382*	A	-0.325	A	1.220***	--	-0.968**	A	0.929***	--	-0.757*	A	1.408***	--
8	Vision problems	n/a		0.934***	A	n/a		0.707**	--	n/a		1.106***	C	n/a		0.937**	--	n/a		1.127***	--	n/a		1.350***	--	n/a		0.833***	--
9	Hearing problems	n/a		1.273***	C	n/a		1.637***	--	n/a		0.957*	A	n/a		0.989**	--	n/a		0.762**	--	n/a		0.526	C	n/a		0.694*	A
10	Circulatory problems	-1.842***	--	0.494*	--	-1.384***	--	1.784***	A	-1.315***	A	1.614***	--	-1.404***	--	1.578***	--	-1.637***	A	1.477***	--	-1.375***	A	1.652***	--	-1.202***	--	1.873***	--
11	Respiratory problems	-2.103***	B	0.576***	--	-1.677***	--	0.752**	--	-1.564***	A	1.555***	A	-2.287***	--	1.287***	--	-2.217***	A	1.225***	A	-2.494***	A	1.253***	--	-1.666***	--	1.667***	--
12	Dental problems	n/a		0.765***	B	n/a		0.428**	B	n/a		0.420***	D	n/a		0.835**	C	n/a		See text	n/a	n/a		See text	n/a	n/a		0.717*	A
13	Gastro-intestinal problems	-1.989*	A	0.387*	--	-1.146**	A	0.520*	--	-0.837**	--	1.490***	A	-1.255**	--	1.014***	A	-1.014*	--	1.076***	--	-1.253***	--	0.928***	--	-1.493***	A	1.409***	--
14	Skin problems	n/a		0.890***	D	n/a		0.907***	--	n/a		0.787***	--	n/a		0.707***	A	n/a		0.840***	A	n/a		0.595***	A	n/a		0.700***	--
15	Musculo-skeletal problems	n/a		0.295	B	n/a		0.738***	C	n/a		0.733***	--	n/a		0.628*	A	n/a		0.935***	--	n/a		0.567***	--	n/a		1.014***	--
16	Trauma and injuries	0	n/a	1.090***	--	0	n/a	1.344***	--	-0.638	n/a	1.328***	--	0	n/a	0.705***	--	Tbc		0.897***	A	Tbc		0.576**	A	Tbc		0.556***	A
17	Genito-urinary problems	-2.997	B	0.878***	--	-0.024	C	0.733***	--	-1.977	C	1.015***	A	-0.588	D	0.988***	A	-0.869*	A	1.079***	--	-0.937*	--	0.716***	A	-0.063	B	0.934***	A
18	Maternity and reproductive health	-0.166*	B	0.653***	--	-0.030	A	0.963***	--	-0.057	--	0.563**	--	-0.085	C	0.614**	--	-0.056	B	0.865***	--	-0.121	--	0.678***	A	Tbc		0.757***	A
19	Neonates																												
20	Poisoning and adverse events	n/a		0.658**	--	n/a		2.102***	--	n/a		1.674***	A	n/a		1.107***	--	n/a		1.735***	--	n/a		1.674***	--	n/a		2.327***	--
21	Healthy individuals	n/a		1.246**	--	n/a		1.049	--	n/a		1.296**	C	n/a		0.709	B	n/a		0.507	B	n/a		0.709*	A	n/a		1.538**	A
22	Social care needs	n/a		0.844	B	n/a		1.192*	--	n/a		1.669**	C	n/a		1.702***	--	n/a		1.069*	--	n/a		1.313**	--	n/a		1.587***	A
23	Other (includes GMS/PMS)	n/a		0.564***	B	n/a		0.338***	--	n/a		0.553***	--	n/a		0.447***	A	n/a		0.532***	--	n/a		0.337***	--	n/a		0.687***	A

Notes: (i) see pp3-4 of text for the meaning of the symbols in 're-estimation' columns;

(ii) the 're-estimation' columns for 2009/10 refer to a comparison of the preferred specification for 2009/10 at LA level with the preferred specification for 2008/09 at PCT level.

Part A Overview of results by PBC

Infectious diseases

34. Outcome: Re-estimation of the 2004/05 specification (OLS) using updated data reveals a positive coefficient on expenditure (Table A6). We therefore re-estimated the 2004/05 specification using the IV estimator and this generated a more acceptable result. We could not find any additional instruments to strengthen the instrument set but the 'unpaid carer' variable was added to the set of regressors and the insignificant 'owner occupier' variable was dropped from the set of regressors (see Table A4 and A6).

35. Expenditure: Re-estimation of the 2004/05 specification using updated data generates a reasonable result (see Table A7). The 2004/05 specification excluded five PCTs with very large spends (over £65 per person) but re-estimation using 2003/04 data reveals that we can obtain a satisfactory result by only excluding the two PCTs with the very largest expenditure figures (£116 and £133) and this is our preferred result (see Table A5 and A7).

Cancer and tumours

36. Outcome: Re-estimation of the 2004/05 specification with updated data reveals an acceptable result (Table A4 and Table A6).

37. Expenditure: Re-estimation of the 2004/05 specification with updated data generates an acceptable result (Table A7) but the specification can be re-estimated without the insignificant 'owner occupier' regressor (Table A5 and Table A7).

Blood disorders

38. Expenditure: Re-estimation of the 2004/05 specification reveals that the coefficient on budget is insignificant (Table A7). We tried tinkering with the specification (eg seeing whether any other variables wanted to be added) but this proved unsuccessful. We therefore re-derived the specification (Table A7) and, as the 'other need' variable appears not to be endogenous, we re-estimated this specification using OLS (see Tables A5 and A7).

Endocrine, nutritional and metabolic

39. Outcome: Re-estimation of the 2004/05 specification using updated data generates an unacceptable result (there is evidence of a weak instrument set: see Table A6). The specification was re-estimated without the insignificant regressor 'CARAN need' but the weak instrument issue remains (see Table A6) and, using the usual pool of needs indicators, we were unable to find any 'strong' instruments. We tried re-deriving the entire specification but this still revealed a problem with weak instruments. Finally, we tried excluding LAs with expenditure outside the 10th and 90th percentiles but this too proved unsuccessful. We concluded that, with the data we have for this year, we cannot find a plausible specification for the diabetes outcome model.

40. Expenditure: Re-estimation of the 2004/05 specification using updated data generates a result that fails the reset test (Table A7). Re-estimation of this specification excluding the two LAs with the largest and smallest amounts of expenditure per person resolves this issue (see Table A5 and Table

A7). [Note that the highest spending LA spends over £60 per person and the second highest spending LA spends less than £40 per person.]

Mental health disorders

41. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Learning disability

42. Expenditure: The 2004/05 specification generates an insignificant coefficient on budget (Table A7). However, the addition of the 'households with no car' variable generates an acceptable result (Table A5 and A7).

Neurological problems

43. Outcome: The 2004/05 specification (excluding those LAs with expenditure per head outside the 5th and 95th percentiles) generates an OK result in some ways but fails the reset test (Table A6). If we examine whether any other regressor wants to be included in the specification then we find that the addition of the 'need squared' variable generates an acceptable result (see Tables A4 and A6).

44. Expenditure: The 2004/05 specification generates the acceptable result shown in Table A5 and Table A7.

Problems of vision

45. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Problems of hearing

46. Expenditure: The 2004/05 specification generates a poor result in the sense that the coefficient on 'other need' is positive and significant (see Table A7). The addition of the IMD variable renders the coefficient on 'other need' insignificant (Table A7) but OLS estimation of this revised specification generates a significant positive coefficient on 'other need'. Hence our preferred specification is the revised IV one (see Tables A5 and A7).

Circulatory problems

47. Outcome: The 2004/05 specification generates the acceptable result shown in Tables A4 and A6.

48. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Respiratory problems

49. Outcome: The 2004/05 specification generates an acceptable result (see Tables A4 and A6).

50. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Dental problems

51. Expenditure: As Table A7 shows, the 2004/05 specification [*] generates a poor result with an insignificant coefficient on budget (as was the case for 2004/5, this excludes LAs spending outside the 5th and 95th percentiles). However, if only LAs spending outside the 1st and 99th percentiles are excluded then we obtain the acceptable result shown in Tables A5 and A7. [*Remember that we could not obtain an acceptable specification for expenditure in 2004/05 but our starting point for 2003/04 is the re-derived version for 2004/05.]

Gastro-intestinal problems

52. Outcome: The 2004/05 specification produces a result that is acceptable in some ways but it fails the reset test (see Table A6). However, the addition of the 'permanently sick' variable remedies this issue (see Tables A4 and A6).

53. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Skin problems

54. Expenditure: The 2004/05 specification generates an acceptable result (Table A7) but we can drop the insignificant 'working in agriculture' regressor and re-estimate. If we do this we obtain the result shown in Tables A5 and A7.

Musculo-Skeletal system

55. Expenditure: The 2004/05 specification generates an acceptable (see Table A5 and Table A7).

Trauma and injuries

56. Outcome: Awaiting femur fracture and skull fracture SMRs from HSCIC (now NHS Digital).

57. Expenditure: The 2004/05 specification generates an acceptable result in some ways but the 'need' variable is statistically insignificant (Table A7). Using the usual pool of available needs indicators, it was found that the 'lone pensioner' variable provided a significant addition to the specification and the 'need' variable was dropped (see Table A5 and Table A7).

Genito-urinary system

58. Outcome: The coefficient on expenditure in the 2004/05 specification is positive (Table A6). Re-derivation generates a very small but negative coefficient on expenditure. The endogeneity test suggests that OLS estimation would not be inappropriate but OLS reverses the sign on expenditure so our preferred specification is the IV version (see Tables A4 and A6). Sample restrictions, such as excluding those LAs with expenditure beyond the 5th and 95th percentiles, do not help.

59. Expenditure: The 2004/05 specification fails the reset test and both 'needs' variables are insignificant (Table A7). If both 'needs' variables are dropped and we see which other variable wants to enter the specification then we find that the addition of the 'owner occupied' variable generates a satisfactory result (Table A5 and Table A7).

Maternity/Neonates

60. Outcome: Awaiting the infant mortality rate for 20003/4/5 from NHS Digital.

61. Expenditure: The 2004/05 specification generates an acceptable result in some ways but the 'lone pensioner' variable is insignificant (Table A7). If this variable is dropped and the specification re-estimated then we obtain the result shown in both Tables A5 and A7. We examined whether any other variable wanted to be added to the specification but this set of re-estimations offered no improvement.

Poisoning

62. Expenditure: The 2004/05 specification generates an acceptable result (Table A5 and Table A7).

Healthy Individuals

63. Expenditure: The 2004/05 specification [OLS] generates an insignificant coefficient on budget (Table A7). IV re-estimation generates a significant coefficient on budget but there is evidence of instrument invalidity (Table A7). The insignificant regressor 'working in agriculture' was dropped and we added one of the instruments ('lone parents') as a regressor. This pair of adjustments generates the acceptable result shown in Tables A5 and A7.

Social Care

64. Expenditure: The 2004/05 specification generates an insignificant coefficient on budget (Table A7). The sample restriction to LAs with expenditure per head of between £15 and £75 is the same as that employed for 2004/05 but if we remove this restriction and only exclude the two LAs with the smallest amount of expenditure (-£5 and £0.10 per person) together with the LA with the largest amount of expenditure (£117) then we obtain the acceptable result shown in Table A5 and A7.

GMS/PMS

65. Expenditure: The 2004/05 specification related to PBC23a (GMS/PMS expenditure only) but there was no sub-PBC data for 2003/04 (the first year of PB data) so we are forced to use all PBC 23 expenditure here. If we apply the 2004/05 specification to 2003/04 data we obtain the reasonable result shown in Table A7. However, the 2004/05 specification excluded some small and large spending LAs (<£100 and > £200 per person) but, as we are using all PBC23 spend here (rather than just PBC23a), we tried re-estimating the 2004/05 specification without any exclusion restrictions. This generates the reasonable result shown in Table A7 and, if we re-estimate again without the insignificant 'working in agriculture' variable, we obtain our preferred specification (see Table A5 and Table A7).

All PBCs: Comparing specifications for 2003/04 and 2004/05

66. Table A2 summarises whether the preferred specification for each equation is the same as for the previous year ('pass') or, if not, why the previous year's specification is not suitable. For example, this might be because the previous specification does not 'pass' the appropriate statistical tests when estimated on updated data. It could also be because the estimated coefficients are incompatible with our prior beliefs about their sign and significance. For example, one of our priors is that, for the outcome equation, health care expenditure should not have a negative marginal effect on mortality and another is that, in the expenditure equation, budget should have a positive marginal effect on PBC expenditure. In a small number of cases, the previous specification might 'fail' on both statistical tests and on priors.

67. Finally, Table A3 reports the number times where the preferred specification for 2003/04 is OLS and this is the same/similar specification as was preferred for the previous year (i.e., we do not re-derive the OLS specification).

Table A2 Nature of failure of previous year's specification when applied to the following year's data

PBC #	PBC Title	2009/10 Outcome	2009/10 Expenditure	2008/09 Outcome	2008/09 Expenditure	2007/08 Outcome	2007/08 Expenditure	2006/07 Outcome	2006/07 Expenditure	2005/06 Outcome	2005/06 Expenditure	2004/05 Outcome	2004/05 Expenditure	2003/04 Outcome	2003/04 Expenditure
1	Infectious diseases	Tests		Tests		Tests		Tests	Tests			Tests	Tests		
2	Cancers and tumours		Prior (A)				Prior (A)	Tests		Tests	Tests				
3	Diseases of the blood	n/a	Prior (A)	n/a		n/a		n/a		n/a		n/a	Prior (C)	n/a	Prior (A)
4	Endocrine, nutritional, metabolic	Tests			Prior (A)	Tests, prior		Tests	Prior (C)			Tests	Prior (C)	n/a	Tests
5	Mental health disorders	n/a													
6	Learning disability	n/a	Tests	n/a		n/a		n/a	Test, prior(A, C)	n/a	Prior (A)	n/a		n/a	Prior (A)
7	Neurological problems	Prior		Tests		Prior	Tests	Tests, prior	Test, prior(C)	Tests				Tests	
8	Vision problems	n/a	Priors (A, C)	n/a		n/a	Tests	n/a		n/a		n/a		n/a	
9	Hearing problems	n/a	Priors (A, C)	n/a		n/a	Prior [B]	n/a		n/a		n/a	Prior (A, C)	n/a	Prior (B)
10	Circulatory problems				Prior (A)	Tests				Tests		Tests			
11	Respiratory problems	Tests				Tests	Prior (A)			Tests	Tests				
12	Dental problems	n/a	Tests	n/a	Test, prior (B, C)	n/a	Test, prior [B]	n/a	Prior (C)	n/a	Test, prior(B)	n/a	n/a	n/a	n/a
13	Gastro-intestinal problems	Tests					Prior (A)		Tests					Tests	
14	Skin problems	n/a	Tests	n/a		n/a		n/a	Prior (C)	n/a	Prior (C)	n/a	Prior(B)	n/a	
15	Musculo-skeletal problems	n/a	Prior (A)	n/a	Prior (A)	n/a		n/a	Prior (B)	n/a		n/a		n/a	
16	Trauma and injuries	n/a		n/a		n/a		n/a		n/a	Tests	n/a		n/a	Prior (C)
17	Genito-urinary problems	Prior		Prior		Prior	Prior [C]	Tests	Tests				Tests	Prior	Prior (C)
18	Maternity and reproductive health														
19	Neonates	Tests		Prior				Prior		Tests			Tests	n/a	Prior (C)
20	Poisoning and adverse events	n/a		n/a		n/a	Prior (A)	n/a		n/a		n/a		n/a	
21	Healthy individuals	n/a		n/a		n/a	Prior [A, C]	n/a	Prior(A, B, C)	n/a	Prior (B, C)	n/a		n/a	Test, prior(C)
22	Social care needs	n/a	Prior (C)	n/a		n/a	Prior [C]	n/a		n/a		n/a		n/a	Prior (A)
23	Other (includes GMS/PMS)	n/a	Priors (A, C)	n/a		n/a		n/a	Tests	n/a		n/a		n/a	
Totals	Pass (= blank cell)	n=2	n=12	n=5	n=18	n=3	n=11	n=3	n=11	n=4	n=15	n=6	n=14	n=4	n=12
	Tests	n=5	n=3	n=2	n=0	n=3	n=2	n=4	n=4	n=5	n=3	n=3	n=3	n=2	n=1
	Prior (negative coefficient on expenditure)	n=2		n=2		n=2		n=1		n=0		n=0		n=1	
	Tests and priors	n=0	n=0		n=1	n=1	n=1	n=1	n=2	n=0	n=1	n=0	n=0	n=0	n=1
	Prior (A: 'significant', +ve coefficient on budget)		n=3		n=3		n=4				n=1		n=0		n=3
	Prior (B: no significant +ve coefficient on o/need)		n=0				n=1		n=1		n=0		n=1		n=1
	Prior (C: other coefficients significant)		n=1				n=2		n=3		n=1		n=2		n=3
	Priors (B, C)		n=0				n=0		n=0		n=1		n=0		n=0
	Priors (A, B, C)		n=0				n=0		n=1		n=0		n=0		n=0
	Priors (A, C)		n=3				n=1		n=1		n=0		n=1		n=0

Notes: (i) here, 'previous year' relates to the next year temporally (ie we are working backwards); and

(ii) a 'pass' is recorded if the only change is to drop an insignificant regressor (will be recorded as an 'A' in Table 1) and/or if an IV specification is re-estimated using OLS.

Table A3 OLS specification for previous year and current year

Number of times preferred specification is OLS and the same/similar OLS specification as in the previous year		2008/09	2007/08	2006/07	2005/06	2004/05	2003/04
Outcome equation	(maximum n=9)	n=1	n=1	n=0	n=1	n=2	n=0
Expenditure equation	(maximum n=22)	n=11	n=12	n=12	n=12	n=12	n=13

APPENDIX

Part B Preferred specifications for outcome and expenditure models for 2003/04

In this section, Tables A4 and A5 provide details of our preferred specification for each outcome and expenditure model by PBC for 2003/04.

Table A4 Preferred outcome specifications for 2003/04

VARIABLES	(1) PBC 1 infectious 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 revised	(2) PBC 2 cancer 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 specification	(3) PBC 7 neurological 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 revised	(4) PBC 10 circulatory 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 specification	(5) PBC 11 respiratory 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 specification	(6) PBC 13 gastro 2004/5 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 revised	(7) PBC 17 genito-urinary 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 03 re-derived
ILAg1_34	-0.205 [0.343]						
ILAhivneedph	0.067 [0.072]						
ILAimd_2007exexpobook	0.460*** [0.138]		0.483*** [0.142]				
LWHITEEG03	-0.796*** [0.213]						-1.822*** [0.352]
LPOPPUCAR03	-1.241*** [0.421]						
ILAg2_34OHP		-0.201** [0.094]					
ILAneedCARAN34		0.750*** [0.072]		0.716** [0.341]	3.748*** [0.550]	0.321 [0.594]	
ILAg7_34OHP			-0.751* [0.426]				
LWORKAGRI03			0.129** [0.054]				
ILAneedCARAN342			2.472 [1.856]				
ILAg10_34netpopheadOHP				-1.202*** [0.182]			
LPERMSICK03				0.637*** [0.113]		1.108*** [0.263]	
ILAg11_34OHP					-1.666*** [0.446]		

ILAg13_34netpopheadOHP						-1.493***	
						[0.425]	
ILAg17_34OHP							-0.063
							[0.674]
LNQUAL17403							1.321***
							[0.371]
Constant	-1.843*	5.893***	3.239**	12.254***	9.747***	12.635***	1.263
	[1.082]	[0.393]	[1.296]	[1.023]	[1.777]	[2.414]	[2.895]
Observations	144	151	135	151	151	151	151
Endogeneity test statistic	0.928	4.945	2.165	32.851	28.292	11.906	0.038
Endogeneity p-value	0.336	0.026	0.141	0.000	0.000	0.001	0.846
Kleibergen-Paap LM test statistic	7.931	16.583	12.542	19.283	13.403	14.162	17.836
Kleibergen-Paap p-value	0.005	0.000	0.002	0.000	0.000	0.000	0.000
Kleibergen-Paap F statistic	9.795	10.257	10.043	55.862	28.447	24.260	24.694
Pesaran-Taylor reset statistic	0.641	0.047	0.834	0.009	1.210	0.000	0.177
Pesaran-Taylor p-value	0.423	0.828	0.361	0.924	0.271	0.995	0.674
Hansen-Sargan test statistic		0.971	0.501				
Hansen-Sargan p-value		0.324	0.479				

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A5 Preferred expenditure specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PBC 1	PBC 2	PBC 3	PBC 4	PBC 5	PBC 6	PBC 7	PBC 8	PBC 9	PBC 10
	infectious	cancer	blood	endocrine	mental health	LDisability	neurological	vision	hearing	circulatory
	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/04 spend	2003/04 spend	2003/4 spend	2003/4 spend	2003/4 spend
	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5/	SYLLR 2003/04/05	SYLLR 2003/04/05	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5
	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model
	instrument n/a	instrument o/need	instrument n/a	instrument n/a	instrument n/a	instrument n/a	instrument n/a	instrument o/need	instrument o/need	instrument o/need
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	OLS	IV second stage	OLS	OLS	OLS	OLS	OLS	IV second stage	IV second stage	IV second stage
		GMM2S						GMM2S	GMM2S	GMM2S
	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level
	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality
	actual census 03	actual census 03	actual census 03	actual census 04	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03
VARIABLES	04/05 revised	04/05 specification	re-derived OLS	04/05 revised	04/05 specification	04/05 revised	04/05 specification	04/05 specification	04/05 revised	04/05 specification
ILAgall_34netpopheadOHP	1.094*** [0.254]	1.711*** [0.294]	0.652* [0.381]	0.653*** [0.113]	1.333*** [0.162]	0.646* [0.331]	1.408*** [0.205]	0.833*** [0.276]	0.694* [0.407]	1.873*** [0.288]
ILAhivneedph	0.274*** [0.033]									
ISYLLRacExlandP345	-0.075 [0.183]									
ILAhivneedph2	0.138*** [0.027]									
ISYLLRacExCancer345		-1.088*** [0.237]								
LPROFOCCU03		-0.460*** [0.126]								
ISYLLRallcause345			0.321 [0.333]		-0.155 [0.143]	0.204 [0.263]		-0.612** [0.301]	0.768 [0.487]	
LBORNEXEU03			0.110*** [0.036]							
ILANeedCARAN34			0.222 [0.420]							
LNQUAL17403				0.274*** [0.061]				0.744*** [0.141]		0.907*** [0.120]
LWHITEEG03				-0.162* [0.090]						
ISYLLRacExDIA345				-0.234** [0.112]						
ILAmhneedindexpp					0.308* [0.157]					
LPOPPUCAR03					-0.597*** [0.107]				0.865*** [0.259]	
LHHNOCAR03						-0.426*** [0.142]				
ILANeedCARAN342						1.262 [1.176]				
ILAepiprev0304							0.319*** [0.114]			
ISYLLRacExEPI345							-0.492*** [0.139]			
LLONEPENH03									-0.646**	

LPC74LTUN03									[0.271]	
									-0.463***	
LLONEPARH03									[0.134]	
									-0.428	
ILAIMD_2007EXEXPBOOK									[0.269]	
									0.423**	
ISYLLRACEXCIRC345									[0.187]	
										-1.759***
										[0.335]
Constant	-4.412***	-2.084	-3.602	0.584	-4.828***	-2.782	-1.831	2.111*	-11.683***	3.212**
	[1.181]	[1.347]	[2.926]	[0.797]	[1.559]	[2.716]	[1.298]	[1.225]	[3.401]	[1.305]
Observations	147	151	150	149	151	137	151	151	151	151
R-squared	0.623		0.244	0.366	0.665	0.098	0.330			
Ramsey reset F statistic	1.280		1.021	2.043	1.403	0.678	0.144			
Probability > F	0.284		0.386	0.111	0.244	0.567	0.934			
Endogeneity test statistic		9.775						3.979	0.261	21.240
Endogeneity p-value		0.002						0.046	0.609	0.000
Kleibergen-Paap LM test statistic		26.685						31.247	20.340	23.015
Kleibergen-Paap p-value		0.000						0.000	0.000	0.000
Kleibergen-Paap F statistic		45.579						35.891	28.335	19.117
Pesaran-Taylor reset statistic		0.185						0.437	0.580	1.931
Pesaran-Taylor p-value		0.667						0.509	0.446	0.165
Hansen-Sargan test statistic								0.101	0.129	0.288
Hansen-Sargan p-value								0.751	0.720	0.592

Robust standard errors in brackets

*** p<0.01, ** p<0.05, *

p<0.1

Table A5 continued Preferred expenditure specifications for 2003/04

	(1) PBC 11 respiratory 2003/4 spend	(2) PBC 12 dental 2003/4 spend	(3) PBC 13 gastro 2004/5 spend	(4) PBC 14 skin problems 2003/04 spend	(5) PBC 15 musculo-skeletal 2003/04 spend	(6) PBC 16 trauma 2003/4 spend	(7) PBC 17 genito- 2003/4 spend	(8) PBC 1819 mat/neonates 2003/04 spend infant mort rate 2003/04/05 spend model o/need exogenous weighted OLS	(9) PBC 20 poisoning 2003/4 spend
	SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03	SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03 04/05 1/99 specification	SYLLR 2004/5/6 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03	SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 04	SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03	SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03			
VARIABLES	04/05 specification	specification	04/05 specification	04/05 revised	04/05 specification	04/05 revised	04/05 revised	04/05 revised	04/05 specification
ISYLLRallcause345		0.736 [0.448]		0.131 [0.113]	-0.327** [0.164]	0.091 [0.122]		0.136 [0.230]	-1.909*** [0.412]
lAgall_34netpopheadOHP	1.661*** [0.217]	0.717* [0.390]	1.409*** [0.219]	0.700*** [0.128]	1.014*** [0.176]	0.556*** [0.155]	0.934*** [0.193]	0.757*** [0.237]	2.327*** [0.413]
LPOPPUCAR03		0.823* [0.454]							
LNQUAL17403	0.605*** [0.103]	-0.878*** [0.293]	0.706*** [0.100]	0.178** [0.072]					0.860*** [0.168]
LWORKAGRI03		0.092** [0.045]							
ISYLLRacExResp345	-0.857*** [0.274]								
ISYLLRacExGast345			-1.132*** [0.239]						
LPC74LTUN03					-0.165** [0.072]				
LPROFOCCU03					-0.365*** [0.082]				
LLONEPENH03						0.551*** [0.117]			
ISYLLRacExrenal345							-0.097 [0.165]		
LOWNOCC03							-0.403*** [0.124]		
lAmatneedindexpp								0.468*** [0.145]	
Constant	-1.549 [1.126]	-6.011** [2.659]	2.171* [1.212]	-2.418*** [0.859]	-2.161 [1.684]	0.783 [0.900]	-2.077** [0.921]	-1.977 [1.790]	-1.079 [1.587]
Observations	151	147	151	151	151	151	151	151	151
R-squared		0.133		0.391	0.265	0.346	0.498	0.326	
Endogeneity test statistic	10.155		9.194						9.308
Endogeneity p-value	0.001		0.002						0.002
Kleibergen-Paap LM test statistic	26.355		25.192						30.213

Kleibergen-Paap p-value	0.000		0.000						0.000
Kleibergen-Paap F statistic	48.934		96.403						35.169
Pesaran-Taylor reset statistic	0.177		0.021						0.010
Pesaran-Taylor p-value	0.674		0.886						0.919
Ramsey reset F statistic		1.802		1.640	0.560	1.379	1.993	0.301	
Probability > F		0.150		0.183	0.642	0.251	0.118	0.824	
Hansen-Sargan test statistic									0.584
Hansen-Sargan p-value									0.445

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A5 continued Preferred expenditure specifications for 2003/04

	(1) PBC 21 HI 2003/4 spend SYLLR 2003/04/05 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 IV revised	(2) PBC 22 social care 2003/04 spend SYLLR 2003/04/05 spend model o/need exogenous weighted OLS LA-level actual mortality actual census 03 04/05 revised	(3) PBC 23 GMS 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03 04/05 revised
VARIABLES			
ISYLLRallcause345	-2.190** [0.983]	-1.539*** [0.381]	-0.117 [0.116]
ILAgall_34netpopheadOHP	1.538** [0.606]	1.581*** [0.513]	0.681*** [0.144]
LLONEPARH03	1.088** [0.505]		
LWHITEEG03			-0.423*** [0.083]
Constant	8.683 [5.661]	1.534 [2.555]	0.831 [0.876]
Observations	151	148	151
R-squared		0.093	0.297
Endogeneity test statistic	7.348		
Endogeneity p-value	0.007		
Hansen-Sargan test statistic	3.994		
Hansen-Sargan p-value	0.136		
Kleibergen-Paap LM test statistic	32.122		
Kleibergen-Paap p-value	0.000		
Kleibergen-Paap F statistic	19.387		
Pesaran-Taylor reset statistic	0.000		
Pesaran-Taylor p-value	0.985		
Ramsey reset F statistic		2.020	0.584
Probability > F		0.114	0.627

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX

Part C Estimation path to preferred specifications for outcome and expenditure models for 2003/04

In this section, Tables A5 and A6 provide details of the estimation path to our preferred specifications for each outcome and expenditure model by PBC for 2003/04. For each PBC, we first estimate the model for 2003/04 using our preferred specification for 2004/05. If this specification fails to meet either the necessary statistical tests or our prior beliefs about the sign/size/significance of coefficients, then the specification is adjusted in line with our estimation strategy outlined on pp2-3 and the model is re-estimated. This process continues until we identify a specification that meets our priors and passes the relevant statistical tests. The final, preferred specification for each PBC for 2003/04 is also shown here, along with the results associated with the estimation of selected intermediate specifications.

Table A6 Estimation path to preferred outcome specifications for 2003/04

	(1) PBC 1 infectious 2003/4 spend SYLLR 2003/4/5 outcome model instrument n/a weighted OLS	(2) PBC 1 infectious 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(3) PBC 1 infectious 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(4) PBC 2 cancer 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(5) PBC 4 endocrine 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(6) PBC 4 endocrine 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(7) PBC 7 neurological 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(8) PBC 7 neurological 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level	(9) PBC 10 circulatory 2003/4 spend SYLLR 2003/4/5 outcome model instrument spend weighted IV second stage GMM2S LA-level
VARIABLES	04/05 specification	specification	04/05 revised	04/05 specification	04/05 specification	04/05 revised	04/05 specification	04/05 revised	04/05 specification
ILAhivneedph	0.114** [0.050]	0.137** [0.063]	0.067 [0.072]						
ILAIMD_2007EXEXPBOOK	0.175** [0.086]	0.202** [0.097]	0.460*** [0.138]		0.542*** [0.161]	0.559*** [0.145]	0.441*** [0.141]	0.483*** [0.142]	
LOWNOCC03	-0.351 [0.264]	-0.493 [0.381]							
LWHITEEG03	-0.798*** [0.197]	-0.836*** [0.210]	-0.796*** [0.213]						
ILAg1_34	0.107 [0.090]	-0.117 [0.390]	-0.205 [0.343]						
LPOPPUCAR03			-1.241*** [0.421]						
ILAg2_34OHP				-0.201** [0.094]					
ILANeedCARAN34				0.750*** [0.072]					0.716** [0.341]
ILAg4_34OHP					-1.258 [1.414]	-1.428 [1.281]			

ILAdiaprev0304					0.691*	0.714*			
					[0.402]	[0.403]			
ILAneedCARAN342					0.620			2.472	
					[1.641]			[1.856]	
ILAg7_34OHP							-0.719*	-0.751*	
							[0.437]	[0.426]	
LWORKAGRI03							0.103**	0.129**	
							[0.052]	[0.054]	
ILAg10_34netpopheadOHP									-1.202***
									[0.182]
LPERMSICK03									0.637***
									[0.113]
Constant	0.909***	1.387	-1.843*	5.893***	6.158	6.761	3.179**	3.239**	12.254***
	[0.298]	[0.870]	[1.082]	[0.393]	[5.402]	[5.019]	[1.319]	[1.296]	[1.023]
Observations	144	144	144	151	137	137	135	135	151
R-squared	0.535								
Ramsey reset F statistic	1.221								
Probability > F	0.305								
Endogeneity test statistic		0.395	0.928	4.945	1.038	1.559	2.218	2.165	32.851
Endogeneity p-value		0.530	0.336	0.026	0.308	0.212	0.136	0.141	0.000
Kleibergen-Paap LM test statistic		6.920	7.931	16.583	3.023	3.887	12.923	12.542	19.283
Kleibergen-Paap p-value		0.009	0.005	0.000	0.082	0.049	0.002	0.002	0.000
Kleibergen-Paap F statistic		8.633	9.795	10.257	3.641	4.879	10.310	10.043	55.862
Pesaran-Taylor reset statistic		0.261	0.641	0.047	1.782	1.026	5.667	0.834	0.009
Pesaran-Taylor p-value		0.610	0.423	0.828	0.182	0.311	0.017	0.361	0.924
Hansen-Sargan test statistic				0.971			0.450	0.501	
Hansen-Sargan p-value				0.324			0.502	0.479	

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A6 continued Estimation path to preferred outcome specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)
	PBC 11	PBC 13	PBC 13	PBC 17	PBC 17
	respiratory	gastro	gastro	genito-	genito-urinary
	2003/4 spend				
	SYLLR 2003/4/5				
	outcome model				
	instrument spend	instrument spend	instrument spend	instrument n/a	instrument spend
	weighted	weighted	weighted	weighted	weighted
	IV second stage	IV second stage	IV second stage	OLS	IV second stage
	GMM2S	GMM2S	GMM2S		GMM2S
	LA-level	LA-level	LA-level	LA-level	LA-level
	actual mortality				
	actual census 03				
VARIABLES	04/05 specification	04/05 specification	04/05 revised	4/5 specification	re-derived
ILAg11_34OHP	-1.666*** [0.446]				
ILAneedCARAN34	3.748*** [0.550]	3.020*** [0.358]	0.321 [0.594]		
ILAg13_34netpopheadOHP		-1.110*** [0.386]	-1.493*** [0.425]		
LPERMSICK03			1.108*** [0.263]		
ILAg17_34netpopheadOHP				0.467 [0.388]	
LNQUAL17403				1.145*** [0.371]	1.321*** [0.371]
LWHITEEG03				-1.689*** [0.318]	-1.822*** [0.352]
ILAg17_34OHP					-0.063 [0.674]
Constant	9.747*** [1.777]	7.689*** [1.595]	12.635*** [2.414]	-1.054 [1.615]	1.263 [2.895]
Observations	151	151	151	137	151
Endogeneity test statistic	28.292	10.069	11.906		0.038
Endogeneity p-value	0.000	0.002	0.001		0.846
Kleibergen-Paap LM test statistic	13.403	16.904	14.162		17.836
Kleibergen-Paap p-value	0.000	0.000	0.000		0.000
Kleibergen-Paap F statistic	28.447	30.475	24.260		24.694
Pesaran-Taylor reset statistic	1.210	3.113	0.000		0.177
Pesaran-Taylor p-value	0.271	0.078	0.995		0.674
R-squared				0.199	
Ramsey reset F statistic				0.200	
Probability > F				0.897	

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A7 Estimation path to preferred expenditure specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PBC 1	PBC 1	PBC 2	PBC 2	PBC 3	PBC 3	PBC 3	PBC 4	PBC 4	PBC 5
	infectious	infectious	cancer	cancer	blood	blood	blood	endocrine	endocrine	mental health
	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend				
	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5/	SYLLR 2003/4/5	SYLLR 2003/4/5/				
	spend model	spend model	spend model	spend model	spend model	spend model				
	instrument n/a	instrument n/a	instrument o/need	instrument o/need	instrument n/a	instrument o/need	instrument n/a	instrument n/a	instrument n/a	instrument n/a
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	OLS	OLS	IV second stage	IV second stage	OLS	IV second stage	OLS	OLS	OLS	OLS
	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level
	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality				
	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03				
VARIABLES	04/05 specification	04/05 revised	04/05 specification	04/05 specification	04/05 specification	re-derived	re-derived OLS	04/05 specification	04/05 revised	04/05 specification
ILAgall_34netpopheadOHP	1.074*** [0.250]	1.094*** [0.254]	1.680*** [0.315]	1.711*** [0.294]	0.365 [0.391]	0.689** [0.344]	0.652* [0.381]	0.674*** [0.121]	0.653*** [0.113]	1.333*** [0.162]
ILAhivneedph	0.243*** [0.036]	0.274*** [0.033]								
ISYLLRacExlandP345	-0.049 [0.180]	-0.075 [0.183]								
ILAhivneedph2	0.109*** [0.029]	0.138*** [0.027]								
ISYLLRacExCancer345			-1.545*** [0.535]	-1.088*** [0.237]						
LPROFOCCU03			-0.726*** [0.268]	-0.460*** [0.126]						
LOWNOCC03			-0.366 [0.313]		-0.555*** [0.180]					
ISYLLRallcause345					0.324 [0.247]	-0.087 [0.412]	0.321 [0.333]			-0.155 [0.143]
LBORNEXEU03						0.130*** [0.031]	0.110*** [0.036]			
ILAneedCARAN34						0.740 [0.561]	0.222 [0.420]			
LNQUAL17403								0.310*** [0.067]	0.274*** [0.061]	
LWHITEEG03								-0.273** [0.134]	-0.162* [0.090]	
ISYLLRacExDIA345								-0.281** [0.116]	-0.234** [0.112]	
ILAmhneedindexpp										0.308* [0.157]
LPOPPUCAR03										-0.597*** [0.107]
Constant	-4.436*** [1.174]	-4.412*** [1.181]	0.269 [2.170]	-2.084 [1.347]	-2.174 [2.279]	-1.279 [3.376]	-3.602 [2.926]	0.760 [0.844]	0.584 [0.797]	-4.828*** [1.559]
Observations	144	147	151	151	150	150	150	151	149	151
R-squared	0.544	0.623			0.231		0.244	0.372	0.366	0.665
Ramsey reset F statistic	0.953	1.280			0.257		1.021	10.373	2.043	1.403
Probability > F	0.417	0.284			0.856		0.386	0.000	0.111	0.244

Endogeneity test statistic	8.097	9.775	1.147
Endogeneity p-value	0.004	0.002	0.284
Kleibergen-Paap LM test statistic	12.445	26.685	35.047
Kleibergen-Paap p-value	0.000	0.000	0.000
Kleibergen-Paap F statistic	12.254	45.579	32.937
Pesaran-Taylor reset statistic	0.000	0.185	0.590
Pesaran-Taylor p-value	0.988	0.667	0.442

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A7 continued Estimation path to preferred expenditure specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PBC 6	PBC 6	PBC 7	PBC 8	PBC 9	PBC 9	PBC 10	PBC 11	PBC 12	PBC 12
	LDisability 2003/04 spend SYLLR 2003/04/05 spend model instrument n/a weighted OLS	LDisability 2003/04 spend SYLLR 2003/04/05 spend model instrument n/a weighted OLS	neurological 2003/04 spend SYLLR 2003/04/05 spend model instrument n/a weighted OLS	vision 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level	hearing 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level	hearing 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level	circulatory 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level	respiratory 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level	dental 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS	dental 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS
VARIABLES	04/05 specification	04/05 revised	04/05 specification	04/05 specification	04/05 specification	04/05 revised	04/05 specification	04/05 specification	04/05 5/95 specification	04/05 1/99 specification
ILAgall_34netpopheadOHP	0.163 [0.350]	0.646* [0.331]	1.408*** [0.205]	0.833*** [0.276]	0.824** [0.400]	0.694* [0.407]	1.873*** [0.288]	1.661*** [0.217]	0.393 [0.327]	0.717* [0.390]
LHHNOCAR03		-0.426*** [0.142]								
ILANeedCARAN342	1.421 [1.297]	1.262 [1.176]								
ISYLLRallcause345	-0.331 [0.235]	0.204 [0.263]		-0.612** [0.301]	1.407*** [0.485]	0.768 [0.487]			0.609 [0.431]	0.736 [0.448]
ILAepi prev0304			0.319*** [0.114]							
ISYLLRacExEPI345			-0.492*** [0.139]							
LNQUAL17403				0.744*** [0.141]			0.907*** [0.120]	0.605*** [0.103]	-0.696** [0.294]	-0.878*** [0.293]
LLONEPENH03					-0.605** [0.283]	-0.646** [0.271]				
LPOPPUCAR03					0.837*** [0.256]	0.865*** [0.259]			0.609 [0.415]	0.823* [0.454]
LPC74LTUN03					-0.302** [0.119]	-0.463*** [0.134]				
LLONEPARH03					-0.430 [0.277]	-0.428 [0.269]				
ILAIMD_2007exexpobook						0.423** [0.187]				
ISYLLRacExCirc345							-1.759*** [0.335]			
ISYLLRacExResp345								-0.857*** [0.274]		
LWORKAGRI03									0.056 [0.044]	0.092** [0.045]
Constant	4.464*** [1.631]	-2.782 [2.716]	-1.831 [1.298]	2.111* [1.225]	-14.514*** [3.259]	-11.683*** [3.401]	3.212** [1.305]	-1.549 [1.126]	-3.424 [2.497]	-6.011** [2.659]
Observations	137	137	151	151	151	151	151	151	138	147
R-squared	0.029	0.098	0.330						0.071	0.133
Ramsey reset F statistic	1.110	0.678	0.144						1.168	1.802

Probability > F	0.348	0.567	0.934						0.325	0.150
Endogeneity test statistic				3.979	0.230	0.261	21.240	10.155		
Endogeneity p-value				0.046	0.631	0.609	0.000	0.001		
Kleibergen-Paap LM test statistic				31.247	28.072	20.340	23.015	26.355		
Kleibergen-Paap p-value				0.000	0.000	0.000	0.000	0.000		
Kleibergen-Paap F statistic				35.891	37.445	28.335	19.117	48.934		
Pesaran-Taylor reset statistic				0.437	0.332	0.580	1.931	0.177		
Pesaran-Taylor p-value				0.509	0.565	0.446	0.165	0.674		
Hansen-Sargan test statistic				0.101	0.031	0.129	0.288			
Hansen-Sargan p-value				0.751	0.860	0.720	0.592			

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table A7 continued Estimation path to preferred expenditure specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PBC 13	PBC 14	PBC 14	PBC 15	PBC 16	PBC 16	PBC 17	PBC 17	PBC 1819	PBC 1819
	gastro	skin problems	skin problems	musculo-skeletal	trauma	trauma	genito-	genito-	mat/neonates	mat/neonates
	2003/4 spend	2003/04 spend	2003/04 spend	2003/04 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/4 spend	2003/04 spend	2003/04 spend
	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5	SYLLR 2003/4/5
	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model
	instrument o/need	instrument n/a	instrument n/a	instrument n/a	instrument n/a	instrument n/a	instrument n/a	instrument n/a	o/need exogenous	o/need exogenous
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	IV second stage	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	GMM2S									
	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level	LA-level
	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality
	actual census 03	actual census 04	actual census 04	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03	actual census 03
VARIABLES	04/05 specification	04/05 specification	04/05 revised	04/05 specification	04/05 specification	04/05 revised	04/05 specification	04/05 revised	04/05 specification	04/05 revised
ILAgall_34netpopheadOHP	1.409*** [0.219]	0.697*** [0.129]	0.700*** [0.128]	1.014*** [0.176]	0.644*** [0.233]	0.556*** [0.155]	1.143*** [0.231]	0.934*** [0.193]	0.741*** [0.248]	0.757*** [0.237]
ISYLLRallcause345		0.163 [0.141]	0.131 [0.113]	-0.327** [0.164]	-0.130 [0.173]	0.091 [0.122]			0.106 [0.235]	0.136 [0.230]
LNQUAL17403	0.706*** [0.100]	0.163* [0.085]	0.178** [0.072]							
LWORKAGRI03		0.006 [0.019]								
ISYLLRacExGast345	-1.132*** [0.239]									
LPC74LTUN03				-0.165** [0.072]			0.912 [0.612]			
LPROFOCCU03				-0.365*** [0.082]						
ILAneedCARAN34					0.248 [0.314]					
LLONPENH03						0.551*** [0.117]			0.109 [0.213]	
ISYLLRacExrenal345							-0.164 [0.247]	-0.097 [0.165]		
LPC74LTUN03SQ							0.090 [0.068]			
LOWNOCC03								-0.403*** [0.124]		
ILAmatneedindexpp									0.533*** [0.201]	0.468*** [0.145]
Constant	2.171* [1.212]	-2.583*** [0.919]	-2.418*** [0.859]	-2.161 [1.684]	0.440 [2.037]	0.783 [0.900]	-0.679 [2.041]	-2.077** [0.921]	-1.467 [2.201]	-1.977 [1.790]
Observations	151	151	151	151	151	151	151	151	151	151
R-squared		0.391	0.391	0.265	0.227	0.346	0.452	0.498	0.327	0.326
Endogeneity test statistic	9.194									
Endogeneity p-value	0.002									
Kleibergen-Paap LM test statistic	25.192									
Kleibergen-Paap p-value	0.000									
Kleibergen-Paap F statistic	96.403									
Pesaran-Taylor reset statistic	0.021									

Pesaran-Taylor p-value	0.886									
Ramsey reset F statistic		1.623	1.640	0.560	0.418	1.379	3.686	1.993	0.195	0.301
Probability > F		0.187	0.183	0.642	0.741	0.251	0.014	0.118	0.900	0.824
Robust standard errors in brackets										
*** p<0.01, ** p<0.05, * p<0.1										

Table A7 continued Estimation path to preferred expenditure specifications for 2003/04

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PBC 20 poisoning 2003/4 spend SYLLR 2003/4/5 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03	PBC 21 HI 2003/04 spend SYLLR 2003/04/05 spend model o/need exogenous weighted OLS LA-level actual mortality actual census 03	PBC 21 HI 2003/4 spend SYLLR 2003/04/05 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03 04/05 specification IV	PBC 21 HI 2003/4 spend SYLLR 2003/04/05 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 03	PBC 22 social care 2003/04 spend SYLLR 2003/04/05 spend model o/need exogenous weighted OLS LA-level actual mortality actual census 03	PBC 22 social care 2003/04 spend SYLLR 2003/04/05 spend model o/need exogenous weighted OLS LA-level actual mortality actual census 03	PBC 23 GMS 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03	PBC 23 GMS 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03	PBC 23 GMS 2003/4 spend SYLLR 2003/4/5 spend model instrument n/a weighted OLS LA-level actual mortality actual census 03
VARIABLES	04/05 specification	04/05 specification	04/05 specification	04/05 IV revised	04/05 specification	04/05 revised	04/05 specification	04/05 revised	04/05 revised
ISYLLRallcause345	-1.909*** [0.412]	0.083 [0.310]	-0.447 [0.438]	-2.190** [0.983]	-0.923*** [0.329]	-1.539*** [0.381]	-0.106 [0.104]	-0.150 [0.115]	-0.117 [0.116]
ILAgall_34netpopheadOHP	2.327*** [0.413]	0.609 [0.421]	1.092** [0.501]	1.538** [0.606]	0.443 [0.438]	1.581*** [0.513]	0.526*** [0.145]	0.673*** [0.147]	0.681*** [0.144]
LNQUAL17403	0.860*** [0.168]								
LWORKAGRI03		-0.008 [0.042]	-0.032 [0.042]				-0.008 [0.019]	-0.020 [0.021]	
LLONEPARH03				1.088** [0.505]					
LWHITEEG03							-0.256** [0.101]	-0.358*** [0.114]	-0.423*** [0.083]
Constant	-1.079 [1.587]	-1.894 [2.266]	-2.106 [2.177]	8.683 [5.661]	5.907*** [2.117]	1.534 [2.555]	1.818** [0.864]	1.001 [0.894]	0.831 [0.876]
Observations	151	151	151	151	102	148	134	151	151
R-squared		0.039			0.099	0.093	0.236	0.301	0.297
Endogeneity test statistic	9.308		4.587	7.348					
Endogeneity p-value	0.002		0.032	0.007					
Hansen-Sargan test statistic	0.584		7.700	3.994					
Hansen-Sargan p-value	0.445		0.053	0.136					
Kleibergen-Paap LM test statistic	30.213		26.609	32.122					
Kleibergen-Paap p-value	0.000		0.000	0.000					
Kleibergen-Paap F statistic	35.169		62.154	19.387					
Pesaran-Taylor reset statistic	0.010		1.462	0.000					
Pesaran-Taylor p-value	0.919		0.227	0.985					
Ramsey reset F statistic		0.907			0.255	2.020	0.293	0.493	0.584
Probability > F		0.439			0.858	0.114	0.830	0.688	0.627

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Appendix 2: Expected health opportunity costs in the NHS (2003/04 results)

Overview

68. In the second appendix results are presented that reflect the available data for 2003/04 expenditure (this forms Appendix 2.1). In Appendix 2.2, the results are also analysed in terms of how sensitive the results are to two key inputs: i) each of the estimated elasticities and ii) assumptions made in order to overcome data limitations for each PBC (only have mortality outcome data and for only a portion of PBCs). Finally, Appendix 2.3 briefly considers an update regarding data from ONS used to inform burden of disease.

Appendix 2.1 Results

69. Results are presented in two ways as the point estimate of the cost per QALY of marginal activity in the NHS, or alternatively expressed as the expected QALY health opportunity cost for £10,000,000 expenditure.

Table A8 Deterministic results for 2003/04 compared to previously generated results

Year	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Cost per QALY	£6,381	£5,389	£7,613	£6,844	£9,747	£12,960	£9,887
Health opportunity costs of £10mn (QALYs)	1,567	1,856	1,314	1,461	1,026	772	1,011

70. It can be seen from Table A8 that the expected health opportunity costs of a given level of expenditure have decreased between 2004/05 and 2003/04 and so the cost per QALY ratio has increased. The associated uncertainty with each of these results is presented in Table A9 and figures A1 and A2 below.

Table A9 Probabilistic results for 2003/04 compared to previously generated results

2003/04	Point estimate (deterministic)	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£6,381	£6,381	£5,048	£8,534
Health opportunity costs of £10mn (QALYs)	1,567	1,567	1,172	1,981
2004/05	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£5,389	£5,377	£4,110	£7,517
Health opportunity costs of £10mn (QALYs)	1,856	1,860	1,330	2,433
2005/06	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£7,613	£7,635	£5,611	£11,619
Health opportunity costs of £10mn (QALYs)	1,314	1,310	861	1,782
2006/07	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£6,844	£6,838	£5,139	£9,878
Health opportunity costs of £10mn (QALYs)	1,461	1,462	1,012	1,946
2007/08	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£9,747	£9,765	£7,689	£13,043
Health opportunity costs of £10mn (QALYs)	1,026	1,024	767	1,301
2008/09	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£12,960	£13,271	£8,390	£32,881
Health opportunity costs of £10mn (QALYs)	772	754	304	1,192
2009/10	Point estimate	Point estimate (probabilistic)	5th percentile	95th percentile
Cost per QALY	£9,887	£9,920	£6,802	£17,296
Health opportunity costs of £10mn (QALYs)	1,011	1,008	578	1,470

It can be seen from Table A9 that the expected health opportunity costs of a change in expenditure have decreased slightly between 2004/05 and 2003/04 and so the cost per QALY ratio has risen, which probably results from the additional PBCs in which no outcome elasticity could be reasonably estimated (PBCs 4 and 18+19). In this table, the uncertainty associated with these estimates is shown and it can be judged to what extent any changes in the point estimate between years should

be interpreted as a signal of any trend. From Table A9 it is hard to conclude that there is a significant change in the health opportunity costs of £10mn expenditure, since there is a great deal of overlap between the 90% confidence intervals of the years shown.

Figure A1 Results illustrating uncertainty for 2003/04 and previously generated results – cost per QALY

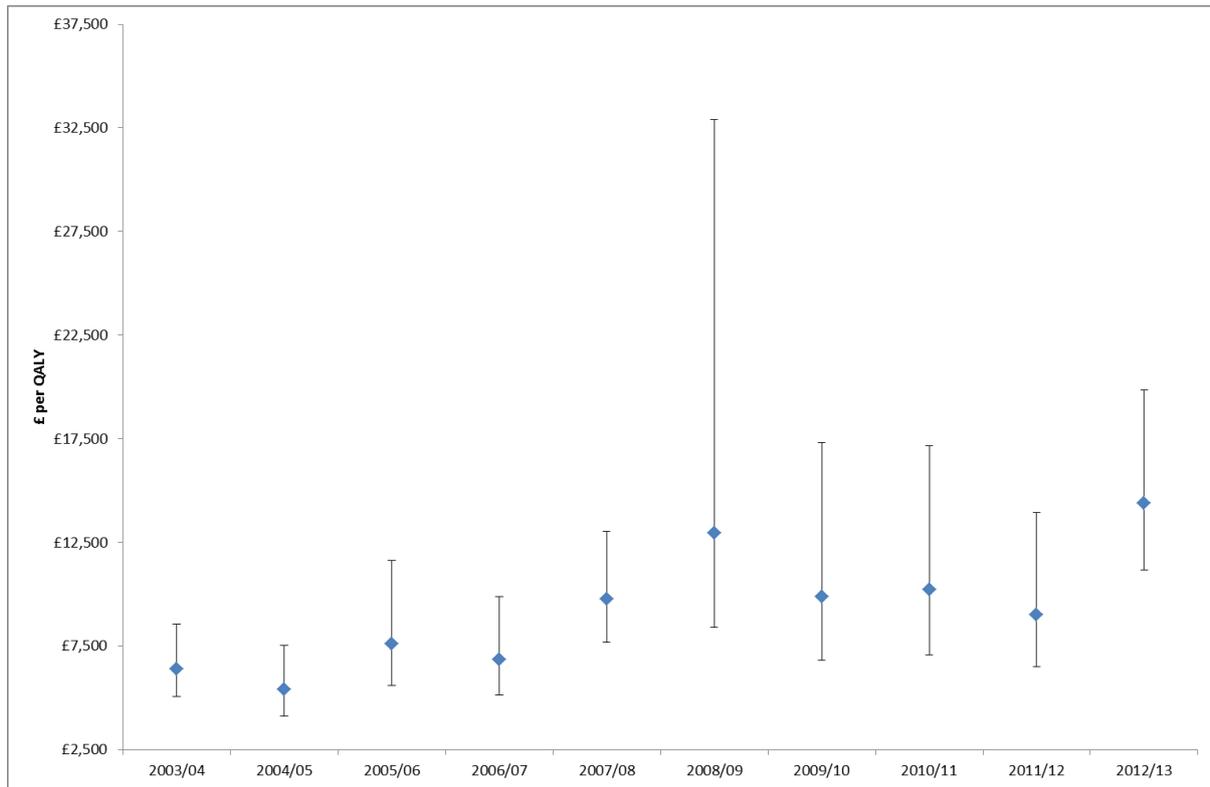
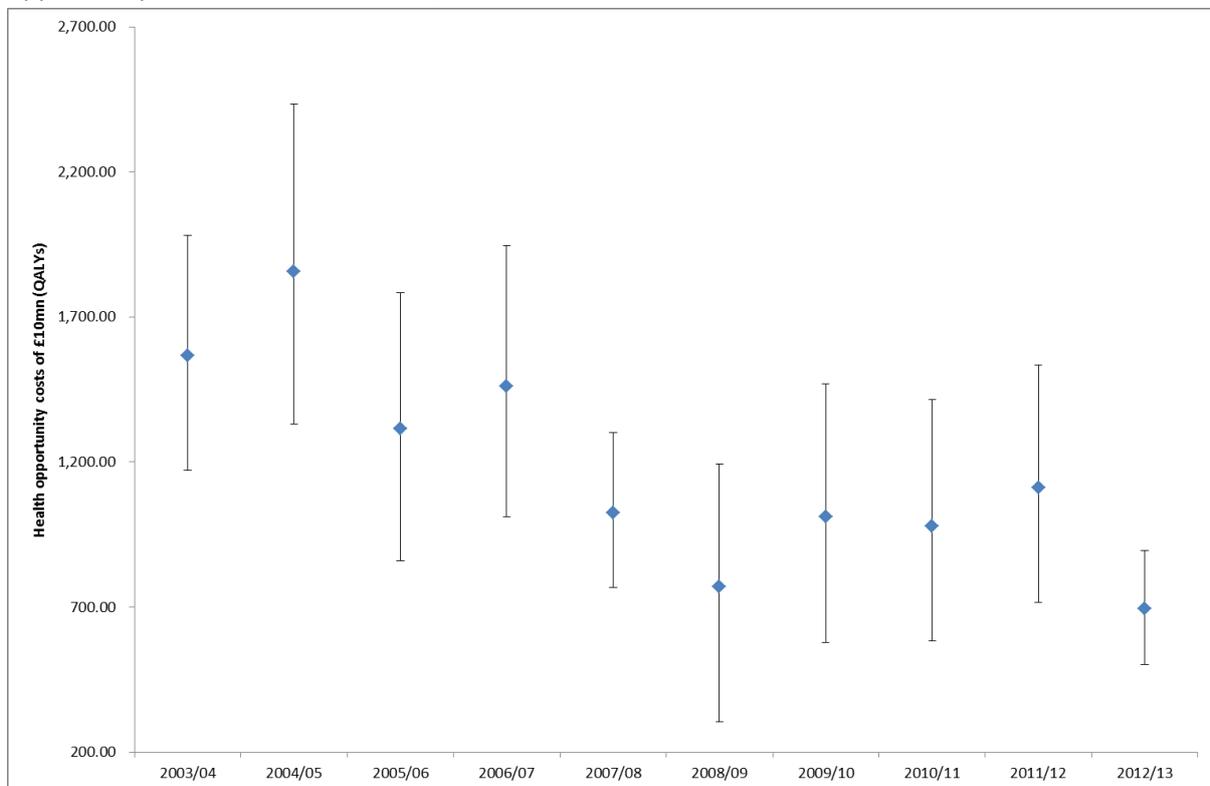


Figure A2 Results illustrating uncertainty for 2003/04 and previously generated results – Health opportunity costs of £10mn (QALYs)



71. It can also be seen from Figures A1 and A2 that while the confidence interval is far from symmetrically distributed around the point estimate of the cost per QALY ratio in Figure A1 (where uncertainty is reflected in the denominator), when expressed as health opportunity costs per £10mn then the distribution of uncertainty is much more symmetric in Figure A2 (uncertainty is reflected in the numerator).

72. It is also possible to generate implied cost per QALY ratio results for each individual PBC. If taken at face values then these results would have important policy implications, for example to divest from one PBC, perhaps maternity and neonates (PBCs 18 and 19), and to invest in another, for example respiratory (PBC 11). There are good reasons why this should not happen, namely potential 'spillovers' between PBCs and the assumption of proportionality between the effect of changes in expenditure on the QALY burden disease and the estimated proportionate effect on the mortality burden, which may be more appropriate for some PBCs than others. In Table A10, we consider how cost per QALY ratios for specific PBCs vary over time.

Table A10 Implied PBC cost per QALY ratios over time

	Implied PBC cost per QALY (£) 2003/04	Implied PBC cost per QALY (£) 2004/05	Implied PBC cost per QALY (£) 2005/06	Implied PBC cost per QALY (£) 2006/07	Implied PBC cost per QALY (£) 2007/08	Implied PBC cost per QALY (£) 2008/09
2 Cancer	£ 17,553.77	£ 18,010.10	£ 27,667.77	£ 18,273.98	£ 17,640.20	£ 17,594.59
10 Circulatory	£ 5,479.44	£ 5,486.45	£ 4,844.61	£ 5,823.96	£ 6,571.01	£ 6,665.70
11 Respiratory	£ 1,433.26	£ 1,121.13	£ 1,394.46	£ 1,295.46	£ 1,971.96	£ 2,151.60
13 Gastro-intestinal	£ 5,507.38	£ 7,380.94	£ 9,954.11	£ 7,290.71	£ 11,292.57	£ 8,602.65
1 Infectious diseases	£ 40,054.96	£ 81,496.11	£ 19,452.54	£ 12,275.48	£ 12,886.90	£ 19,030.88
4 Endocrine	N/A	£ 1,385.07	£ 2,916.06	£ 2,078.60	£ 2,198.46	£ 2,270.96
7 Neurological	£ 1,513.13	£ 1,395.10	£ 4,677.53	£ 2,301.18	£ 9,165.34	£ 7,504.74
17 Genito-urinary	£ 993,371.49	£ 71,170.46	£ 78,439.80	£ 116,616.35	£ 33,836.19	£ 2,978,823.26
16 Trauma & injuries*	N/A	N/A	N/A	N/A	N/A	N/A
18+19 Maternity & neonates*	N/A	£ 3,065,589.00	£ 7,526,403.52	£ 4,613,479.53	£ 6,260,414.86	£ 12,313,490.13
3 Disorders of Blood	£ 4,087.18	£ 3,913.33	£ 4,703.82	£ 4,053.46	£ 5,977.55	£ 8,676.28
5 Mental Health	£ 7,846.43	£ 6,854.56	£ 8,673.25	£ 8,254.65	£ 11,278.69	£ 17,250.44
6 Learning Disability	£ 60,828.25	£ 55,174.37	£ 69,200.60	£ 65,320.04	£ 92,084.50	£ 137,944.35
8 Problems of Vision	£ 20,530.56	£ 18,293.13	£ 21,838.83	£ 18,951.38	£ 27,118.28	£ 42,138.55
9 Problems of Hearing	£ 2,637.35	£ 2,308.45	£ 2,675.78	£ 2,407.59	£ 3,935.06	£ 5,753.54
12 Dental problems	£ 4,402.41	£ 4,390.74	£ 9,432.19	£ 17,863.94	£ 25,722.64	£ 39,088.10
14 Skin	£ 39,351.03	£ 37,032.09	£ 46,661.01	£ 44,709.25	£ 60,419.56	£ 92,974.01
15 Musculo skeletal	£ 7,226.20	£ 6,699.23	£ 8,159.61	£ 6,620.05	£ 9,469.74	£ 14,382.87
20 Poisoning and AE	£ 36,041.07	£ 36,384.72	£ 49,191.19	£ 45,750.52	£ 62,464.12	£ 104,500.87
21 Healthy Individuals	£ 179,538.76	£ 159,784.55	£ 214,734.17	£ 200,069.12	£ 294,658.13	£ 484,677.80
22 Social Care Needs	N/A	N/A	N/A	N/A	N/A	N/A
23 Other	N/A	N/A	N/A	N/A	N/A	N/A

73. The results in Table A10 for each PBC are largely driven by two key variables: each PBC's estimated outcome elasticity and the changing burden of disease for PBCs. Expenditure elasticities only affect PBCs without a mortality signal through the mortality elasticity used for extrapolation, which depends upon expenditure elasticities. As a result, the variations observed in Table A10 reflect variations that can be seen in the elasticities found in Table A1.

Appendix 2.2 Sensitivity analysis

74. Appendix 2.2 details three sensitivity analyses that were performed. The first two concerned the elasticities that were econometrically estimated for each of the PBCs. In the first case each of the estimated PBC outcome elasticities are varied by +/- 1 standard error. Then, the difference between the two resulting opportunity costs is presented. When this is larger, this implies that the overall resulting estimate of health opportunity costs is more sensitive to the outcome elasticity under consideration. The same procedure is then carried out for each of the PBC expenditure elasticities. The results of these sensitivity analyses are reported in Tables A11 and A12.

Table A11 Sensitivity of results to estimated outcome elasticities

	Change in spend	Change in QALY death + QALY alive	Implied PBC cost per QALY (£)	Difference in health opportunity costs between +1 SE and -1 SE in PBC outcome elasticity	% difference in health opportunity costs between +1 SE and -1 SE in PBC outcome elasticity	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2 Cancer	£ 911,210.15	52	£ 17,553.77	68	4.32%	5	6	6	6	5	6
10 Circulatory	£ 1,690,998.53	309	£ 5,479.44	150	9.56%	3	3	3	2	3	4
11 Respiratory	£ 743,564.59	519	£ 1,433.26	324	20.65%	1	1	1	1	1	2
13 Gastro-intestinal	£ 734,239.81	133	£ 5,507.38	89	5.66%	4	5	5	4	4	5
1 Infectious diseases	£ 161,048.46	4	£ 40,054.96	15	0.97%	6	8	7	7	8	7
4 Endocrine	£ 155,074.55	0	N/A	-	-	-	4	4	3	2	3
7 Neurological	£ 344,372.07	228	£ 1,513.13	266	16.97%	2	2	2	5	6	1
17 Genito-urinary	£ 423,602.76	0	£ 993,371.49	14	0.91%	7	7	8	8	7	8
16 Trauma & injuries*	£ 284,061.56	0	N/A	-	-	-	-	-	-	-	-
18+19 Maternity & neonates*	£ 397,234.35	0	N/A	-	-	-	9	9	9	9	9
3 Disorders of Blood	£ 75,278.14	18	£ 4,087.18	-	-	-	-	-	-	-	-
5 Mental Health	£ 1,457,006.85	186	£ 7,846.43	-	-	-	-	-	-	-	-
6 Learning Disability	£ 200,877.21	3	£ 60,828.25	-	-	-	-	-	-	-	-
8 Problems of Vision	£ 168,084.71	8	£ 20,530.56	-	-	-	-	-	-	-	-
9 Problems of Hearing	£ 32,613.89	12	£ 2,637.35	-	-	-	-	-	-	-	-
12 Dental problems	£ 63,364.79	14	£ 4,402.41	-	-	-	-	-	-	-	-
14 Skin	£ 120,429.35	3	£ 39,351.03	-	-	-	-	-	-	-	-
15 Musculo skeletal	£ 510,126.85	71	£ 7,226.20	-	-	-	-	-	-	-	-
20 Poisoning and AE	£ 184,707.54	5	£ 36,041.07	-	-	-	-	-	-	-	-
21 Healthy Individuals	£ 255,882.47	1	£ 179,538.76	-	-	-	-	-	-	-	-
22 Social Care Needs	£ 321,633.83	0	N/A	-	-	-	-	-	-	-	-
23 Other	£ 764,587.55	0	N/A	-	-	-	-	-	-	-	-

Total: 1,567

Table A12 Sensitivity of overall results to estimated spend elasticities

	Change in spend	Change in QALY death + QALY alive	Implied PBC cost per QALY (£)	Difference in health opportunity costs between +1 SE and -1 SE in PBC spend elasticity	% difference in health opportunity costs between +1 SE and -1 SE in PBC spend elasticity	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2 Cancer	£ 911,210.15	52	£ 17,553.77	42	2.65%	6	4	4	8	8	11
10 Circulatory	£ 1,690,998.53	309	£ 5,479.44	42	2.68%	5	12	2	9	2	2
11 Respiratory	£ 743,564.59	519	£ 1,433.26	117	7.45%	1	1	1	1	1	1
13 Gastro-intestinal	£ 734,239.81	133	£ 5,507.38	0	0.01%	22	14	12	18	12	13
1 Infectious diseases	£ 161,048.46	4	£ 40,054.96	14	0.88%	12	16	14	19	21	19
4 Endocrine	£ 155,074.55	0	N/A	11	0.73%	14	10	11	12	10	3
7 Neurological	£ 344,372.07	228	£ 1,513.13	47	3.00%	4	3	19	6	19	18
17 Genito-urinary	£ 423,602.76	0	£ 993,371.49	37	2.35%	7	5	5	4	11	6
16 Trauma & injuries*	£ 284,061.56	0	N/A	34	2.14%	8	2	3	7	6	8
18+19 Maternity & neonates*	£ 397,234.35	0	N/A	53	3.36%	2	8	7	2	5	4
3 Disorders of Blood	£ 75,278.14	18	£ 4,087.18	8	0.49%	18	21	15	20	18	22
5 Mental Health	£ 1,457,006.85	186	£ 7,846.43	10	0.66%	15	15	20	15	20	12
6 Learning Disability	£ 200,877.21	3	£ 60,828.25	29	1.84%	11	9	9	5	7	10
8 Problems of Vision	£ 168,084.71	8	£ 20,530.56	12	0.77%	13	13	13	16	15	17
9 Problems of Hearing	£ 32,613.89	12	£ 2,637.35	9	0.54%	16	18	17	17	13	20
12 Dental problems	£ 63,364.79	14	£ 4,402.41	5	0.31%	20	22	21	11	14	14
14 Skin	£ 120,429.35	3	£ 39,351.03	6	0.37%	19	17	16	14	16	16
15 Musculo skeletal	£ 510,126.85	71	£ 7,226.20	3	0.21%	21	20	22	22	22	21
20 Poisoning and AE	£ 184,707.54	5	£ 36,041.07	8	0.54%	17	19	18	21	17	15
21 Healthy Individuals	£ 255,882.47	1	£ 179,538.76	30	1.94%	10	11	10	13	9	5
22 Social Care Needs	£ 321,633.83	0	N/A	33	2.09%	9	6	6	10	3	7
23 Other	£ 764,587.55	0	N/A	51	3.23%	3	7	8	3	4	9

Total: 1,567

75. Generally, the results display varying degrees of sensitivity to estimated elasticities depending upon the PBC under consideration. In general, but not always, the results are more sensitive to specific PBC outcome elasticities than to specific PBC spend elasticities. Looking first at Table A12, for many PBCs, the difference between the overall health opportunity cost when the spend elasticity is increased by one standard error compared to the result when the standard error is reduced by one standard error represents less than 1% of the overall point estimate of health opportunity costs (PBCs 13, 1, 4, 3, 5 8, 9, 12, 14 15 and 20). This difference is never greater than 10% for any single PBC with PBC 11 (respiratory) where the difference is 7.45%. Switching to look at Table A11 it can be seen that the most important PBC in terms of outcome elasticity sensitivity is PBC 11: respiratory, as it is when spend elasticity is considered. The overall estimated health opportunity cost is also sensitive to PBC 7 (neurological) and to a lesser extent PBC 10 (circulatory).

76. Following these two sensitivity analyses, a third is performed with a different emphasis, which analyses the sensitivity of the overall health opportunity cost estimate to two key assumptions:

Surrogacy- we are required to make an assumption about how the effect on mortality for PBCs with a mortality indicator can be used as a *surrogate* for the effect that expenditure has on morbidity (or health-related quality of life) in those PBCs.

Extrapolation- We are required to make an assumption about how the estimated effects on mortality found for PBCs with a mortality indicator can be *extrapolated* to the effect that expenditure has on mortality for those PBCs that do not have a mortality indicator.

In order to assess the impact of these assumptions on the overall results for the NHS, we evaluate the health effects of £10mn spending at the margin in the NHS when either:

- a) For PBCs with a mortality indicator: no surrogacy assumption, therefore expenditure has no effect on morbidity
- b) For PBCs without a mortality indicator: assume no health effects at all, neither on mortality (extrapolation assumption) nor morbidity (surrogacy assumption)

The results are found here in Table A13.

Table A13 Sensitivity of overall results to surrogacy and extrapolation assumptions

	Change in spend	Change in QALY death	Change in QALY alive	Health opportunity costs sensitivity to mortality/morbidity assumption (%)	Importance of PBC (rank)	Importance of PBC (rank) 2004/05	Importance of PBC (rank) 2005/06	Importance of PBC (rank) 2006/07	Importance of PBC (rank) 2007/08	Importance of PBC (rank) 2008/09
2 Cancer	£ 911,210.15	48	4	-0.25%	12	15	16	15	14	14
10 Circulatory	£ 1,690,998.53	207	102	-6.48%	4	5	3	4	3	5
11 Respiratory	£ 743,564.59	6	513	-32.71%	1	1	1	1	1	1
13 Gastro-intestinal	£ 734,239.81	46	87	-5.56%	5	7	7	6	5	6
1 Infectious diseases	£ 161,048.46	1	3	-0.20%	14	17	12	11	10	10
4 Endocrine	£ 155,074.55	0	0	0.00%	-	4	6	3	4	4
7 Neurological	£ 344,372.07	10	218	-13.88%	2	2	4	5	7	3
17 Genito-urinary	£ 423,602.76	0	0	-0.02%	17	13	13	13	11	18
16 Trauma & injuries*	£ 284,061.56	0	0	0.00%	-	-	-	-	-	-
18+19 Maternity & neonates*	£ 397,234.35	0	0	0.00%	-	19	19	19	19	19
3 Disorders of Blood	£ 75,278.14	1	17	-1.18%	7	8	8	8	8	9
5 Mental Health	£ 1,457,006.85	16	169	-11.85%	3	3	2	2	2	2
6 Learning Disability	£ 200,877.21	1	3	-0.21%	13	16	17	17	17	15
8 Problems of Vision	£ 168,084.71	0	8	-0.52%	10	10	11	12	12	12
9 Problems of Hearing	£ 32,613.89	0	12	-0.79%	9	11	10	9	9	8
12 Dental problems	£ 63,364.79	0	14	-0.92%	8	9	9	10	13	11
14 Skin	£ 120,429.35	1	2	-0.20%	15	14	15	14	16	13
15 Musculo skeletal	£ 510,126.85	4	67	-4.50%	6	6	5	7	6	7
20 Poisoning and AE	£ 184,707.54	1	4	-0.33%	11	12	14	16	15	16
21 Healthy Individuals	£ 255,882.47	0	1	-0.09%	16	18	18	18	18	17
22 Social Care Needs	£ 321,633.83	0	0	0.00%	-	-	-	-	-	-
23 Other	£ 764,587.55	0	0	0.00%	-	-	-	-	-	-
Total:		342	1,225							
Total change in QALY death + QALY alive			1,567							

77. It can be seen that the surrogacy assumption is especially impactful for PBCs 11 and 7 (respiratory and neurological). Extrapolation and surrogacy is particularly important for PBC 5 (mental health).

Appendix 2.3 Outline of ONS data update for 2003/04

78. The calculation of net YLL by PBC relies on two crucial inputs. The first is data on deaths within each PBC and the age of death, which is then compared to the benchmark of the second input, PBC life expectancy. Each death can then be translated into a number of years of life lost (YLL) if death occurred before the life expectancy and years of life gained (YLG) when the death occurred after the life expectancy. The difference between YLL and YLG gives net YLL, which is an input into the calculation of results. PBC life expectancy itself has to be calculated and relies on data provided by national life tables.

Table A14 Net YLL for 2003-2005, 2004-2006, 2005-2007, 2006-2008, 2007-2009, 2008-2010 and 2009-2011 using LE for each PBC

2003-2005

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	78.7	82.9	78.7	82.9	4,950	36,348
2	82.2	84.1	82.2	84.1	129,596	1,288,974
4	80.1	84.1	80.1	84.1	7,097	50,068
7	78.7	82.6	78.7	82.6	14,201	86,464
10	82.2	85.9	82.2	85.9	180,719	867,752
11	79.4	83.3	79.4	83.3	67,754	21,080
13	79.7	83.8	79.7	83.8	23,470	200,343
17	82.8	84.9	82.8	84.9	8,999	14,839
18+19	77.8	82.3	77.8	82.3	241	17,748

2004-2006

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	79.1	83.3	79.1	83.3	5,878	34,732
2	82.5	84.4	82.5	84.4	129,352	1,312,944
4	80.4	84.4	80.4	84.4	6,835	49,192
7	79.1	82.9	79.1	82.9	14,024	89,958
10	82.5	86.2	82.5	86.2	171,100	851,860
11	79.7	83.6	79.7	83.6	65,824	37,350
13	80.0	84.1	80.0	84.1	23,739	210,088
17	83.1	85.2	83.1	85.2	9,494	16,353
18+19	78.2	82.7	78.2	82.7	228	16,812

2005-2007

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	79.4	83.4	79.4	83.4	6,874	33,965
2	82.8	84.5	82.8	84.5	129,927	1,327,521
4	80.7	84.6	80.7	84.6	6,755	49,589
7	79.4	83.1	79.4	83.1	14,591	91,452
10	82.7	86.3	82.7	86.3	164,630	824,599
11	80.0	83.8	80.0	83.8	65,660	47,301
13	80.3	84.3	80.3	84.3	23,947	217,025
17	83.3	85.4	83.3	85.4	10,100	16,381
18+19	78.5	82.9	78.5	82.9	215	15,833

2006-2008

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	79.6	83.6	79.6	83.6	6,958	36,379
2	83.0	84.7	83.0	84.7	130,810	1,347,324
4	81.0	84.7	81.0	84.7	6,765	50,933
7	79.6	83.3	79.6	83.3	15,353	92,710
10	83.0	86.5	83.0	86.5	159,852	808,850
11	80.3	84.0	80.3	84.0	65,446	61,007
13	80.6	84.5	80.6	84.5	24,147	226,380
17	83.5	85.6	83.5	85.6	10,624	16,669
18+19	78.7	83.1	78.7	83.1	226	16,801

2007-2009

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	79.8	83.8	79.8	83.8	6,288	38,835
2	83.2	84.9	83.2	84.9	131,372	1,355,804
4	81.2	84.9	81.2	84.9	6,762	51,857
7	79.9	83.5	79.9	83.5	16,076	91,442
10	83.2	86.6	83.2	86.6	155,222	785,989
11	80.5	84.2	80.5	84.2	65,026	73,441
13	80.8	84.7	80.8	84.7	23,920	227,224
17	83.7	85.7	83.7	85.7	11,015	15,310
18+19	79.0	83.2	79.0	83.2	255	18,899

2008-2010

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	81.2	84.8	80.1	84.0	5,262	44,445
2	81.2	84.8	83.4	85.1	131,945	1,199,680
4	81.2	84.8	81.4	85.1	6,763	49,504
7	81.2	84.8	80.1	83.7	16,771	111,501
10	81.2	84.8	83.4	86.8	151,443	459,945
11	81.2	84.8	80.7	84.4	64,449	112,633
13	81.2	84.8	81.0	84.9	23,898	231,757
17	81.2	84.8	83.9	85.9	11,345	- 4,085
18+19	81.2	84.8	79.3	83.5	265	20,332

2009-2011

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	80.5	84.3	80.5	84.3	4,907	38,814
2	83.7	85.4	83.7	85.4	132,656	1,395,819
4	81.7	85.4	81.7	85.4	6,477	51,079
7	80.5	84.0	80.5	84.0	17,113	93,164
10	83.6	87.1	83.6	87.1	142,567	768,320
11	81.1	84.7	81.1	84.7	63,088	101,927
13	81.4	85.2	81.4	85.2	23,499	235,041
17	84.1	86.2	84.1	86.2	10,600	16,230
18+19	79.7	83.8	79.7	83.8	252	18,895

Appendix 2.4 Calculation of elasticity for extrapolation and overall NHS mortality elasticities

79. Whilst we have estimated outcome elasticities for PBCs 2, 10, 11, 13, 1, 4, 7, 17 and 18+19, we can also use these to generate an overall to compare with a vast body of literature that estimates the elasticity of all-cause mortality with respect to health care expenditure (Andrews et al., 2016 report an elasticity for 2005/6 English NHS as 0.71). It is worth noting that direct comparison is not possible, since there are substantial methodological differences across publications. An important consideration is that all-cause models may find it harder to detect signal rather than noise, which may cancel out signal, compared to an approach that uses disease-specific models to estimate the effect of expenditure on mortality. The results for an overall mortality elasticity are presented below in Table A15.

Table A15 Estimated overall elasticities

	Elasticity comparable to all-cause model results
2009/10	0.94
2008/09	0.80
2007/08	1.27
2006/07	1.50
2005/06	1.37
2004/05	1.62
2003/04	1.25