

ESTIMATING EXPECTED HEALTH OPPORTUNITY COSTS IN THE NHS

(Analysis of 2011/12 Expenditure Data)

YORK TEAM

Contents:

• Summary of Appendix 1	2
○ Table 1 Outcome and expenditure elasticities for 2008/09, 2009/10, 2010/11 and 2011/12	4
• Summary of Appendix 2	5
○ Table 2 Results for 2011/12 expenditure compared to previously generated result	6
○ Figure 1 Results illustrating uncertainty for 2011/12 and previously generated results – cost per QALY	8
○ Figure 2 Results illustrating uncertainty for 2011/12 and previously generated results – Health opportunity costs of £10mn (QALYs)	8
○ Table 3 Sensitivity of results to estimated outcome elasticities	10
○ Table 4 Sensitivity of overall results to estimated spend elasticities	11
○ Table 5 Sensitivity of overall results to surrogacy and extrapolation assumptions	13
• Appendix 1 Outline of data update, estimation strategy, and results for outcome and expenditure models for 2011/12	14
○ Table A1 Outcome and expenditure elasticities for 2008/09, 2009/10, 2010/11 and 2011/12	16
○ Table A2 Whether the preferred specification for each equation is the same as for the previous years	22
○ Table A3 OLS specification for previous years and current year	23
○ Table A4 Preferred outcome specifications for 2011/12	24
○ Table A5 Preferred expenditure specifications for 2011/12	26
○ Table A6 Estimation path to preferred outcome specifications for 2011/12	31
○ Table A7 Estimation path to preferred expenditure specifications for 2011/12	35
• Appendix 2 Expected health opportunity costs in the NHS (2011/12 results)	42
• Appendix 2.1 Results	42
○ Table A8 Results for 2011/12 compared to previously generated results	42
○ Table A9 results for 2011/12 expenditure compared to previously generated results	43
○ Figure A1 Results illustrating uncertainty for 2011/12 and previously generated results – cost per QALY	45
○ Figure A2 Results illustrating uncertainty for 2011/12 and previously generated results – Health opportunity costs of £10mn (QALYs)	45
• Appendix 2.2 Sensitivity analysis	46
○ Table A10 Sensitivity of results to estimated outcome elasticities	47
○ Table A11 Sensitivity of overall results to estimated spend elasticities	48
○ Table A12 Sensitivity of overall results to surrogacy and extrapolation assumptions	51
• Appendix 2.3 Outline of ONS data update for 2011/12	52
○ Table A13 Net YLL for 2008-2010, 2009-2011, 2010-2012 and 2011-2013 using LE for each PBC	52

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 2011/12

Starting point: the 2010/11 specification

1. Identify the preferred specification for the outcome and expenditure equation for each programme budget category (PBC) for 2010/11. The outcome and expenditure elasticities generated by these specifications are shown in Table 1.

Re-estimate the 2010/11 specifications using updated data

2. The 2010/11 specifications have been derived using a combination PCT-level data mapped to LA-level and direct LA-level data. Update PCT-level data to 2011/12 and put updated PCT-level data through the appropriate mapper to obtain LA-level data. This will include updating and mapping:

- the PB expenditure data from 2010/11 to 2011/12
- the raw population, unified weighted population, and MFF estimates used and implied from the 2011/12 DH resource allocation exposition book
- PB specific indices of need (eg infectious diseases, mental health, maternity) from the DH resource allocation exposition book (where possible)
- PB specific disease prevalence rates as extracted from the HSCIC's QOF database

3. Obtain LA-level statistics for those variables that are reported at this unit of analysis. This will involve updating LA-level data for 2010/11 to 2011/12. This will include updating :

- mortality data for 2010/11/12 with data for 2011/12/13
- census-based variables for 2010 with data for 2011.

Estimation strategy for 2011/12: same as for 2010/11

4. Having updated all data, use the preferred specification for 2010/11 to re-estimate each outcome and expenditure equation for 2011/12.

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 2011/12. This rule is applied to cases where the preferred specification for 2010/11 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 2010/11 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 2010/11 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 2011/12

12. The estimation strategy outlined above generated the outcome and expenditure elasticities for 2011/12 shown in Table 1.

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.

14. The full estimation path for each result (starting with the re-estimation of the 2010/11 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 2008/09, 2009/10, 2010/11 and 2011/12

PBC #	PBC description	for 2008/09				for 2009/10				for 2010/11				for 2011/12				for 2012/13			
		Outcome	/1% or OLS	Spend	/1% or OLS	Outcome	Re-estimation	Spend	Re-estimation												
		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity	
1	Infectious diseases	-0.466**	IV	1471**	OLS	-0.310*	A	0.968***	—	-0.256	A	1006***	—	-0.305***	B	0.841**	—				
2	Cancers and tumours	-0.287***	IV	0.518*	IV	-0.345***	—	0.502**	A	-0.220***	—	0.438	—	-0.430***	A	0.961**	—				
3	Diseases of the blood	n/a		1071**	OLS	n/a		1060***	B	n/a		0.332	B	n/a		0.876***	—				
4	Endocrine, nutritional, metabolic	-0.746*	IV	0.367	IV	-1075**	A	0.708***	—	-0.174	B	0.696***	C	-0.199	—	1116***	A				
5	Mental health disorders	n/a		0.995***	OLS	n/a		0.899***	—	n/a		0.973***	—	n/a		1194***	—				
6	Learning disability	n/a		0.037	IV	n/a		0.647**	B	n/a		1208**	C	n/a		0.741*	D				
7	Neurological problems	-0.304	IV	0.897***	IV	-1357	C	0.850***	—	-0.374	C	0.557***	A	-1415	C	0.703***	A				
8	Vision problems	n/a		0.503	IV	n/a		0.934***	A	n/a		0.997***	—	n/a		1279***	—				
9	Hearing problems	n/a		1223	OLS	n/a		1273***	C	n/a		0.808*	—	n/a		1231**	C				
10	Circulatory problems	-1384***	IV	0.614	IV	-1842***	—	0.494*	—	-1692***	—	1013***	B	-1611**	—	1491**	—				
11	Respiratory problems	-1940***	IV	0.752**	IV	-2103***	B	0.576***	—	-2006**	A	1192***	A	-1743***	—	1360***	A				
12	Dental problems	n/a		0.404**	OLS	n/a		0.765***	B	n/a		0.229	B	n/a		0.843***	C				
13	Gastro-intestinal problems	-1553**	IV	0.520*	IV	-1989*	A	0.387*	—	-1425**	A	1040***	A	-2000**	A	1033***	A				
14	Skin problems	n/a		0.677**	IV	n/a		0.890***	D	n/a		0.422*	B	n/a		0.681**	A				
15	Musculo-skeletal problems	n/a		0.413	IV	n/a		0.295	B	n/a		0.489**	C	n/a		0.456**	C				
16	Trauma and injuries	0	n/a	1344***	OLS	0	B	1090***	—	-0.064	—	0.589**	A	0	B	1024***	A				
17	Genito-urinary problems	-0.346	IV	0.733***	OLS	-2.997	B	0.878***	—	-2.83	B	0.631**	A	-0.494	A	0.598***	—				
18	Maternity and reproductive health																				
19	Neonates	0.043	IV	0.963***	IV	-0.166*	B	0.653***	—	-0.04	B	0.342	—	-0.136	A	0.481**	A				
20	Poisoning and adverse events	n/a		0.674*	IV	n/a		0.658**	—	n/a		1078**	A	n/a		0.631**	—				
21	Healthy individuals	n/a		0.952	OLS	n/a		1246**	—	n/a		1359**	A	n/a		1748***	—				
22	Social care needs	n/a		0.830	OLS	n/a		0.844	B	n/a		1592**	—	n/a		1859***	—				
23	Other (includes GM S/PM S)	n/a		0.494***	OLS	n/a		0.564***	B	n/a		0.520***	—	n/a		0.518**	A				

Notes: (i) see pp12 of text for the meaning of the symbols in 're-estimation' columns;

(ii) there are no 're-estimation' columns for 2008/09 because these results were obtained by re-estimating preferred PCT-level specifications using LA-level data for this year (i.e., there were no changes to model specification).

Summary of Appendix 2: Expected health opportunity costs in the NHS (2011/12 results)

Overview

15. In the second appendix results are presented that reflect the available data for 2011/12 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 results for 2011/12 expenditure compared to previously generated results

2008/09	Point estimate	5th percentile	95th percentile
Cost per QALY	£13,095	£8,158	£38,652
Health opportunity costs of £10mn (QALYs)	764	259	1,226

2009/10	Point estimate	5th percentile	95th percentile
Cost per QALY	£9,662	£6,650	£16,784
Health opportunity costs of £10mn (QALYs)	1,035	596	1,504

2010/11	Point estimate	5th percentile	95th percentile
Cost per QALY	£10,750	£7,468	£18,298
Health opportunity costs of £10mn (QALYs)	930	547	1,339

2011/12	Point estimate	5th percentile	95th percentile
Cost per QALY	£9,643	£6,902	£15,290
Health opportunity costs of £10mn (QALYs)	1037	654	1,449

It can be seen from Table 2 that the expected health opportunity costs of a change in expenditure have increased slightly between 2010/11 and 2011/12 and so the cost per QALY ratio has risen. The health opportunity costs of £10mn are greater than those estimated using 2008/9 data with the re-

applied specifications from the PCT model. 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 2011/12 and previously generated results – cost per QALY

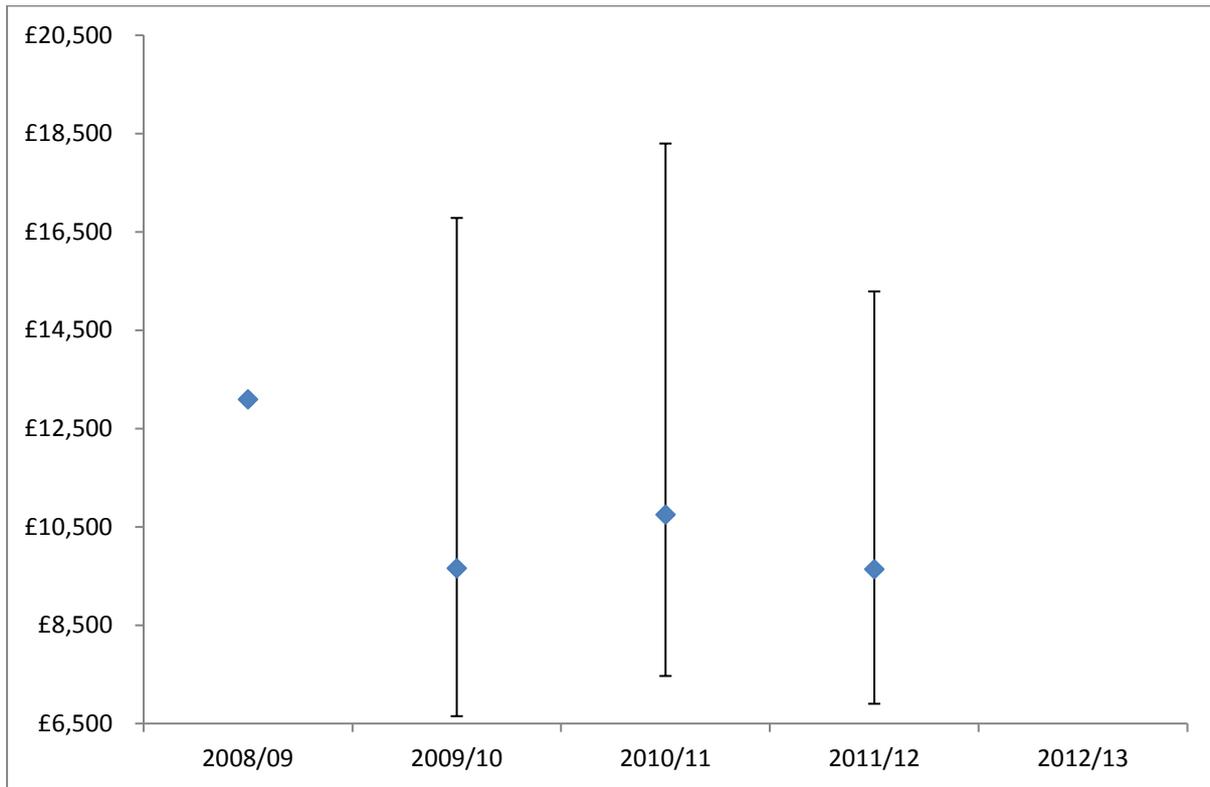
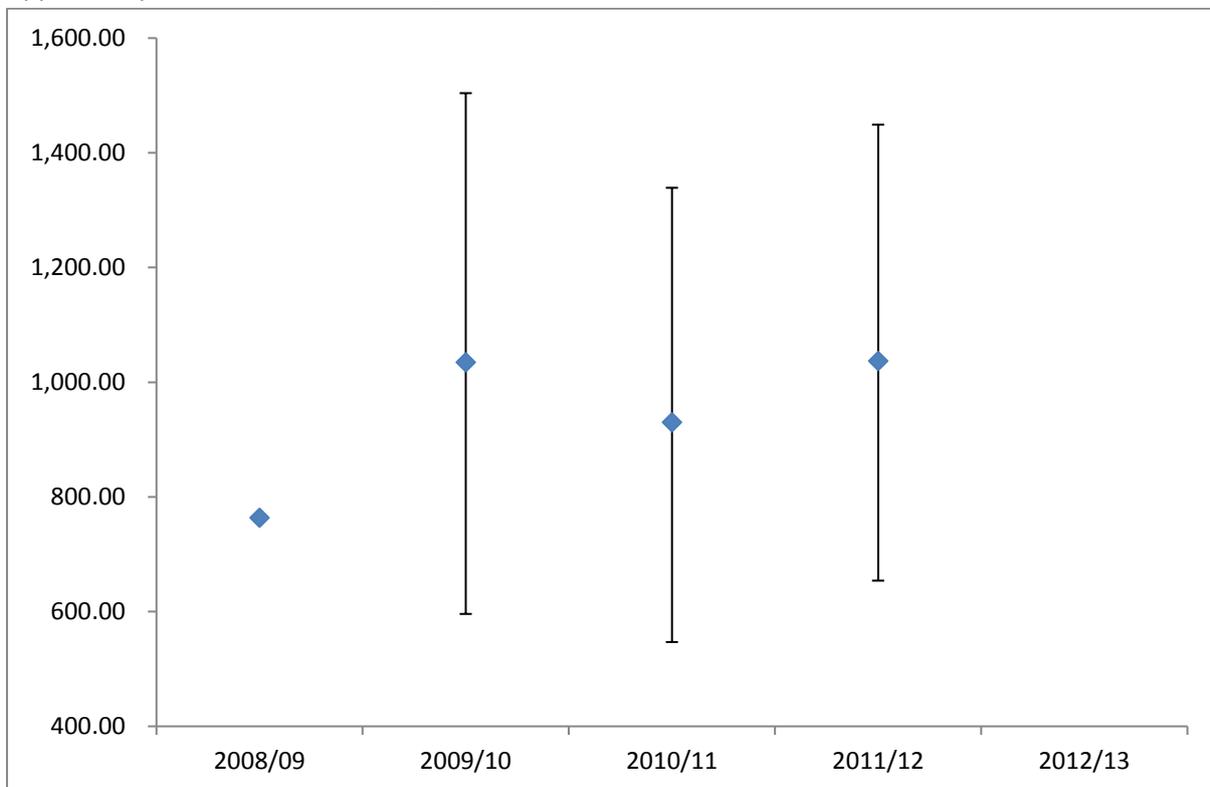


Figure 2 Results illustrating uncertainty for 2011/12 and previously generated results – Health opportunity costs of £10mn (QALYs)



17. The results contained within Table 2 are also represented graphically in Figures 1 and 2. The confidence intervals are presented for results pertaining to 2009/10 elasticities, 2010/11 elasticities and 2011/12 elasticities, but not for 2008/9 elasticities. The reason for this is that the specifications used for 2009/10, 2010/11 and 2011/12 equations were adjusted if a re-application of the previous year's specifications resulted in poor statistical performance (see Appendix 1). The specification of the 2008/9 models, however, were directly taken from Claxton et al. (2015) where there were two key differences: analysis was at PCT and not LA level and census variables used 2001 values not 2008 values (calculated by interpolation between 2001 and 2011 census data). As such, the specification in the 2008/9 models may not have passed all statistical performance tests once moved to LA level and the instruments were updated to 2008 values (e.g 2008/9 specification may possess weak instruments that lead to imprecise coefficient estimation).

18. 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

19. 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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	47	£ 12,952.38	41	3.95%	5	8	7
10 Circulatory	£ 1,198,079.51	182	£ 6,582.53	105	10.09%	4	3	6
11 Respiratory	£ 696,859.54	315	£ 2,210.58	244	23.51%	2	1	2
13 Gastro-intestinal	£ 551,825.16	94	£ 5,851.88	129	12.40%	3	4	4
1 Infectious diseases	£ 144,840.00	3	£ 46,086.46	3	0.27%	8	7	8
4 Endocrine	£ 380,791.13	15	£ 26,211.12	34	3.23%	6	6	5
7 Neurological	£ 348,180.17	204	£ 1,710.05	350	33.71%	1	2	1
17 Genito-urinary	£ 320,948.55	2	£ 215,941.87	22	2.17%	7	5	3
16 Trauma & injuries*	£ 447,630.73	0	£ -	-	-	-	-	-
18+19 Maternity & neonates*	£ 251,898.81	0	£ 3,722,944.22	2	0.19%	9	9	9
3 Disorders of Blood	£ 116,655.70	15	£ 7,638.48	-	-	-	-	-
5 Mental Health	£ 1,547,128.19	103	£ 15,071.81	-	-	-	-	-
6 Learning Disability	£ 138,997.33	2	£ 59,456.35	-	-	-	-	-
8 Problems of Vision	£ 334,959.13	8	£ 43,175.92	-	-	-	-	-
9 Problems of Hearing	£ 66,350.25	14	£ 4,901.31	-	-	-	-	-
12 Dental problems	£ 334,337.22	10	£ 32,012.68	-	-	-	-	-
14 Skin	£ 164,918.76	2	£ 89,752.69	-	-	-	-	-
15 Musculo skeletal	£ 273,242.91	20	£ 13,946.23	-	-	-	-	-
20 Poisoning and AE	£ 71,335.67	1	£ 83,174.39	-	-	-	-	-
21 Healthy Individuals	£ 408,713.94	1	£ 408,841.37	-	-	-	-	-
22 Social Care Needs	£ 610,238.85	0	£ -	-	-	-	-	-
23 Other	£ 978,106.06	0	£ -	-	-	-	-	-

Total: 1,037

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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	47	£ 12,952.38	23	2.26%	9	2	8
10 Circulatory	£ 1,198,079.51	182	£ 6,582.53	25	2.39%	6	6	3
11 Respiratory	£ 696,859.54	315	£ 2,210.58	67	6.49%	2	1	1
13 Gastro-intestinal	£ 551,825.16	94	£ 5,851.88	22	2.12%	10	10	9
1 Infectious diseases	£ 144,840.00	3	£ 46,086.46	10	0.95%	17	12	14
4 Endocrine	£ 380,791.13	15	£ 26,211.12	9	0.83%	18	11	12
7 Neurological	£ 348,180.17	204	£ 1,710.05	86	8.32%	1	19	2
17 Genito-urinary	£ 320,948.55	2	£ 215,941.87	16	1.52%	12	22	22
16 Trauma & injuries*	£ 447,630.73	0	£ -	23	2.26%	8	7	5
18+19 Maternity & neonates*	£ 251,898.81	0	£ 3,722,944.22	25	2.44%	5	5	4
3 Disorders of Blood	£ 116,655.70	15	£ 7,638.48	2	0.17%	22	20	20
5 Mental Health	£ 1,547,128.19	103	£ 15,071.81	21	1.98%	11	13	13
6 Learning Disability	£ 138,997.33	2	£ 59,456.35	13	1.25%	13	8	11
8 Problems of Vision	£ 334,959.13	8	£ 43,175.92	10	0.98%	15	16	16
9 Problems of Hearing	£ 66,350.25	14	£ 4,901.31	4	0.41%	21	18	19
12 Dental problems	£ 334,337.22	10	£ 32,012.68	10	1.00%	14	14	15
14 Skin	£ 164,918.76	2	£ 89,752.69	10	0.97%	16	15	17
15 Musculo skeletal	£ 273,242.91	20	£ 13,946.23	9	0.82%	19	21	21
20 Poisoning and AE	£ 71,335.67	1	£ 83,174.39	6	0.59%	20	17	18
21 Healthy Individuals	£ 408,713.94	1	£ 408,841.37	24	2.35%	7	9	10
22 Social Care Needs	£ 610,238.85	0	£ -	36	3.49%	4	4	6
23 Other	£ 978,106.06	0	£ -	44	4.27%	3	3	7

Total: 1,037

20. 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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	44	3	-0.32%	12	18	16
10 Circulatory	£ 1,198,079.51	127	55	-5.29%	5	4	5
11 Respiratory	£ 696,859.54	17	299	-28.80%	1	1	2
13 Gastro-intestinal	£ 551,825.16	36	58	-5.62%	4	3	6
1 Infectious diseases	£ 144,840.00	1	2	-0.23%	13	14	14
4 Endocrine	£ 380,791.13	1	14	-1.32%	8	9	4
7 Neurological	£ 348,180.17	7	197	-18.97%	2	5	1
17 Genito-urinary	£ 320,948.55	0	1	-0.11%	16	8	10
16 Trauma & injuries*	£ 447,630.73	0	0	0.00%	-	-	-
18+19 Maternity & neonates*	£ 251,898.81	0	0	0.00%	19	19	19
3 Disorders of Blood	£ 116,655.70	1	15	-1.47%	7	11	7
5 Mental Health	£ 1,547,128.19	9	94	-9.90%	3	2	3
6 Learning Disability	£ 138,997.33	1	2	-0.23%	14	12	15
8 Problems of Vision	£ 334,959.13	0	8	-0.75%	11	10	12
9 Problems of Hearing	£ 66,350.25	0	13	-1.31%	9	7	8
12 Dental problems	£ 334,337.22	0	10	-1.01%	10	13	11
14 Skin	£ 164,918.76	1	1	-0.18%	15	16	13
15 Musculo skeletal	£ 273,242.91	1	19	-1.89%	6	6	9
20 Poisoning and AE	£ 71,335.67	0	1	-0.08%	18	15	17
21 Healthy Individuals	£ 408,713.94	0	1	-0.10%	17	17	18
22 Social Care Needs	£ 610,238.85	0	0	0.00%	-	-	-
23 Other	£ 978,106.06	0	0	0.00%	-	-	-

Total: 245 792

Total change in QALY death + QALY alive 1,037

Appendix 1: Outline of data update, estimation strategy, and results for outcome and expenditure models for 2011/12

Starting point: the 2010/11 specification

21. Identify the preferred specification for the outcome and expenditure equation for each programme budget category (PBC) for 2010/11. The outcome and expenditure elasticities generated by these specifications are shown in Table A1.

Re-estimate the 2010/11 specifications using updated data

22. The 2010/11 specifications have been derived using a combination PCT-level data mapped to LA-level and direct LA-level data. Update PCT-level data to 2011/12 and put updated PCT-level data through the appropriate mapper to obtain LA-level data. This will include updating and mapping:

- the PB expenditure data from 2010/11 to 2011/12
- the raw population, unified weighted population, and MFF estimates used and implied from the 2011/12 DH resource allocation exposition book
- PB specific indices of need (eg infectious diseases, mental health, maternity) from the DH resource allocation exposition book (where possible)
- PB specific disease prevalence rates as extracted from the HSCIC's QOF database

23. Obtain LA-level statistics for those variables that are reported at this unit of analysis. This will involve updating LA-level data for 2010/11 to 2011/12. This will include updating :

- mortality data for 2010/11/12 with data for 2011/12/13
- census-based variables for 2010 with data for 2011.

Estimation strategy for 2011/12: same as for 2010/11

24. Having updated all data, use the preferred specification for 2010/11 to re-estimate each outcome and expenditure equation for 2011/12.

25. 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 2011/12. This rule is applied to cases where the preferred specification for 2010/11 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.

26. 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.

27. If a relatively minor adjustment to the 2010/11 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 2010/11 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.

28. 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.

29. Having identified covariates for the second-stage (in 27 above) and instruments for the first-stage (in 28 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.

30. 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.

31. 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 2011/12

32. The estimation strategy outlined above generated the outcome and expenditure elasticities for 2011/12 shown in Table A1.

33. The full result [IV (second-stage) or OLS] associated with each elasticity reported in Table A1 can be found in Table A4 (for the outcome equations) and Table A5 (for the expenditure equations) in the appendix.

34. The full estimation path for each result (starting with the re-estimation of the 2010/11 specification with updated data) can be found in Table A6 (for the outcome equations) and Table A7 (for the expenditure equations) in the appendix.

Table A1 Outcome and expenditure elasticities for 2008/09, 2009/10, 2010/11 and 2011/12

PBC #	PBC description	for 2008/09				for 2009/10				for 2010/11				for 2011/12				for 2012/13			
		Outcome	/1% or OLS	Spend	/1% or OLS	Outcome	Re-estimation	Spend	Re-estimation												
		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity		elasticity	
1	Infectious diseases	-0.466**	IV	1471**	OLS	-0.310*	A	0.968***	—	-0.256	A	1006***	—	-0.305***	B	0.841**	—				
2	Cancers and tumours	-0.287***	IV	0.518*	IV	-0.345***	—	0.502**	A	-0.220***	—	0.438	—	-0.430***	A	0.961**	—				
3	Diseases of the blood	n/a		1071**	OLS	n/a		1060***	B	n/a		0.332	B	n/a		0.876***	—				
4	Endocrine, nutritional, metabolic	-0.746*	IV	0.367	IV	-1075**	A	0.708***	—	-0.174	B	0.696***	C	-0.199	—	1116***	A				
5	Mental health disorders	n/a		0.995***	OLS	n/a		0.899***	—	n/a		0.973***	—	n/a		1194***	—				
6	Learning disability	n/a		0.037	IV	n/a		0.647**	B	n/a		1208**	C	n/a		0.741*	D				
7	Neurological problems	-0.304	IV	0.897***	IV	-1357	C	0.850***	—	-0.374	C	0.557***	A	-1415	C	0.703***	A				
8	Vision problems	n/a		0.503	IV	n/a		0.934***	A	n/a		0.997***	—	n/a		1279***	—				
9	Hearing problems	n/a		1223	OLS	n/a		1273***	C	n/a		0.808*	—	n/a		1231**	C				
10	Circulatory problems	-1384***	IV	0.614	IV	-1842***	—	0.494*	—	-1692***	—	1013***	B	-1611***	—	1491**	—				
11	Respiratory problems	-1940***	IV	0.752**	IV	-2103***	B	0.576***	—	-2006**	A	1192***	A	-1743***	—	1360***	A				
12	Dental problems	n/a		0.404**	OLS	n/a		0.765***	B	n/a		0.229	B	n/a		0.843***	C				
13	Gastro-intestinal problems	-1553**	IV	0.520*	IV	-1989*	A	0.387*	—	-1425**	A	1040***	A	-2000**	A	1033***	A				
14	Skin problems	n/a		0.677**	IV	n/a		0.890***	D	n/a		0.422*	B	n/a		0.681**	A				
15	Musculo-skeletal problems	n/a		0.413	IV	n/a		0.295	B	n/a		0.489**	C	n/a		0.456**	C				
16	Trauma and injuries	0	n/a	1344***	OLS	0	B	1090***	—	-0.064	—	0.589**	A	0	B	1024***	A				
17	Genito-urinary problems	-0.346	IV	0.733***	OLS	-2.997	B	0.878***	—	-2.83	B	0.631**	A	-0.494	A	0.598***	—				
18	Maternity and reproductive health																				
19	Neonates	0.043	IV	0.963***	IV	-0.166*	B	0.653***	—	-0.04	B	0.342	—	-0.136	A	0.481**	A				
20	Poisoning and adverse events	n/a		0.674*	IV	n/a		0.658**	—	n/a		1078**	A	n/a		0.631**	—				
21	Healthy individuals	n/a		0.952	OLS	n/a		1246**	—	n/a		1359**	A	n/a		1748***	—				
22	Social care needs	n/a		0.830	OLS	n/a		0.844	B	n/a		1592**	—	n/a		1859***	—				
23	Other (includes GM S/PM S)	n/a		0.494***	OLS	n/a		0.564***	B	n/a		0.520***	—	n/a		0.518***	A				

Notes: (i) see pp12 of text for the meaning of the symbols in 're-estimation' columns;

(ii) there are no 're-estimation' columns for 2008/09 because these results were obtained by re-estimating preferred PCT-level specifications using LA-level data for this year (i.e., there were no changes to model specification).

Overview of results by PBC

Infectious diseases

35. Outcome: Re-estimation of the 2010/11 specification using updated data suggests that the instrument set is weak (see Table A6). Re-derivation of the specification generates a much stronger instrument set but spend is not endogenous so we prefer the OLS version of the re-derived model (see Table A4 and Table A6).

36. Expenditure: Re-estimation of the 2010/11 specification generates an acceptable result, both statistically and in line with priors (see Table A5 and Table A7).

Cancer and tumours

37. Outcome: Re-estimation of the 2010/11 specification suggests a slightly weak instrument set (Table A6) but, if the least significant instrument is dropped, re-estimation generates an acceptable result (see Table A4 and Table A6).

38. Expenditure: Re-estimation of the 2010/11 specification generates an acceptable result (see Table A5 and Table A7).

Blood disorders

39. Expenditure: Re-estimation of the 2010/11 specification generates an acceptable result (see Table A5 and Table A7).

Endocrine, nutritional and metabolic

40. Outcome: The 2010/11 specification generates an acceptable result (Table A4 and Table A6).

41. Expenditure: The 2010/11 specification generates a plausible result but there is some evidence of mis-specification (Table A7). However, deletion of the insignificant squared 'no qualifications' term remedies this issue (Table A5 and Table A7).

Mental health disorders

42. Expenditure: The 2010/11 specification generates an acceptable result (Table A5 and Table A7).

Learning disability

43. Expenditure: The 2010/11 specification generates a poor result with only one significant variable (Table A7). Re-derivation of the IV specification for 2011/12 generates an acceptable result but the endogeneity test suggests that OLS can be used (Table A7). Re-estimation using OLS generates an acceptable result (Table A5 and Table A7). [Outliers beyond 5%tiles and 95%tiles are excluded.]

Neurological problems

44. Outcome: The 2010/11 specification generates a poor result (Table A6). Re-derivation of the specification followed by the addition of the epilepsy prevalence rate as a regressor generates a more plausible result (Table A4 and Table A6).

45. Expenditure: The 2010/11 specification generates a reasonable result (Table A7). If the insignificant 'lone pensioner' variable is dropped then the 'long term unemployed' variable becomes insignificant too and re-estimation of this specification generates our preferred result (Table A5 and Table A7).

Problems of vision

46. Expenditure: The 2010/11 specification generates an acceptable result (Table A5 and Table A7).

Problems of hearing

47. Expenditure: The 2010/11 specification generates a significant positive coefficient on the 'other needs' variable (Table A7). Re-derivation of the IV specification also generates a significant positive coefficient on the 'other needs' variable (Table A7). To address this issue we tried re-estimating the IV specification with an additional regressor. The significant positive coefficient on the 'other needs' variable disappeared with the addition of either the 'no qualifications' or the 'professional occupations' variable. Both of these specifications suggest a lack of endogeneity so the OLS equivalents can be found in Table A7. Of the two specifications, we prefer the one with the largest R-squared (Table A5).

Circulatory problems

48. Outcome: The 2010/11 specification generates an acceptable result (Table A4 and Table A6).

49. Expenditure: The 2010/11 specification generates an acceptable result (Table A5 and Table A7).

Respiratory problems

50. Outcome: The 2010/11 generates an acceptable result (see Table A4 and Table A6).

51. Expenditure: The 2010/11 specification generates an OK result in some ways but fails the reset test (Table A7). The addition of the squared 'no qualifications' term does not help but the replacement of this squared term with the squared 'CARAN need' variable remedies the reset issue (Table A5 and Table A7). [Remember that for the 2010/11 specification we sometimes found it necessary to replace 'CARAN need' with 'no qualifications' because the former was very highly correlated with total budget.]

Dental problems

52. Expenditure: The 2010/11 specification generates a poor result (see Table A7). Re-derivation of an IV specification generates a more acceptable result but 'other need' is positive and significant (see Table A7). We tried adding another regressor to the specification and the most plausible result is with the addition of the 'professional occupations' variable. 'Other need' is now insignificant and two of the three 'needs' variables are of borderline significance (Table A7). The OLS version of this re-derived specification is less plausible so we stick with the IV version (see Table A5).

Gastro-intestinal problems

53. Outcome: The 2010/11 specification is OK but it reveals that the current instrument (lone pensioners) is a weak one (see Table A6). Using the relevant F-statistic to judge strength, we selected the instrument that generates the most significant coefficient on spend subject to the instrument being a strong one (i.e., with an F-statistic ideally at least 10). This instrument (percentage of households with no car) resolves the weak instrument problem (see Table A4 and Table A6).

54. Expenditure: The 2010/11 specification generates an OK result but the specification fails the RESET test at the 10% level. The addition of the squared 'no qualifications' variable does not improve matters but the addition of 'CARAN need' squared does do so (Table A5 and Table A7).

Skin problems

55. Expenditure: The 2010/11 specification fails the instrument validity test. However, the addition of one of the instruments to the set of second-stage regressors remedies this issue (Table A7) and, if the now insignificant regressor (born outside the EU) is deleted, then we obtain an acceptable result (see Table A5 and Table A7).

Musculo-Skeletal system

56. Expenditure: The coefficient on 'other needs' is positive and significant when the 2010/11 specification is re-estimated with updated data for 2011/12 (Table A7). Re-derivation of the IV specification was not successful and so we returned to the 2010/11 specification and sought to tweak this for an acceptable result.

We tried adding an extra regressor to the specification and obtained a plausible result with the addition of the IMD2010 variable (Table A7 and Table A5). The budget term is positive and significant and 'other need' is no longer significant.

Trauma and injuries

57. Outcome: As was the case for 2010/11, we again have as potential outcome measures SMR<75 for skull fractures and SMR<75 for femur fractures. However, many of the femur fracture observations are missing at LA-level so we use the skull fracture data as our outcome measure. We derived an IV specification but this was problematic (positive coefficient on expenditure, weak instruments, expenditure not endogenous). We therefore reverted to the derived OLS specification which has a very small and statistically insignificant positive coefficient on expenditure (Table A4 and Table A6). This is the same specification as reported for 2010/11.

58. Expenditure: The 2010/11 specification generates an OK result but one regressor is insignificant (Table A7). Re-estimation of the specification without this variable generates the result shown in Table A5 (and Table A7).

Genito-urinary system

59. Outcome: The 2010/11 specification generates an OK result but expenditure is not endogenous (see Table A6). If the insignificant regressor ‘% providing unpaid care’ is dropped and this specification re-estimated as OLS, we obtain the result shown in Table A4 and Table A6. [We also end up with this specification if the specification is re-derived.]

60. Expenditure: The 2010/11 specification generates a plausible result (Table A7 and Table A5).

Maternity/Neonates

61. Outcome: Although the preferred 2010/11 specification was IV, expenditure was not endogenous but IV was retained because the OLS equivalent of the IV specification generated a positive coefficient on expenditure. Re-estimation of the 2010/11 OLS specification generates a plausible result so we do not refer back to the IV specification (see Table A4 and Table A6).

62. Expenditure: The 2010/11 specification generates an acceptable result (Table A7) but expenditure is not endogenous. Re-estimation of this specification using OLS generates a very similar result (see Table A5 and Table A7).

Poisoning

63. Expenditure: The 2010/11 specification generates an acceptable result (Table A5 and Table A7).

Healthy Individuals

64. Expenditure: The 2010/11 specification generates an acceptable result (Table A5 and Table A7).

Social Care

65. Expenditure: The 2010/11 specification generates an acceptable result (see Table A7 and Table A5). [Note that the sample restriction to LAs with expenditure per head of between £15 and £75 is the same as that employed for 2009/10 and 2010/11. This is necessary because there is a large number of ‘outliers’].

GMS/PMS

66. Expenditure: The 2010/11 specification generates a reasonable result (Table A7) but fails the RESET test. We investigated the impact of adding one more regressor to the specification and choose that variable which reversed the RESET failure, generated a plausible (appropriate sign) significant coefficient, and generated the largest R-squared (see Table A5 and Table A7).

All PBCs: Comparing specifications for 2010/11 and 2011/12

67. Table A2 summarises whether the preferred specification for each equation is the same as for the previous year (indicated by a blank cell) 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 (indicated by "Tests"). 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 ("Prior"), in the expenditure equation, budget should have a positive marginal effect on PBC expenditure ("Prior (A)"). In a small number of cases, the previous specification might 'fail' on both statistical tests and on priors.

68. Finally, Table A3 reports the number times where the preferred specification for 2011/12 is OLS and this is the same/similar specification as was preferred for the previous year (i.e., we do not re-derive the specification).

Note

69. 2011/12 was the second year the mortality data used the new European Standard Population.

Table A2 Whether the preferred specification for each equation is the same as for the previous year

PBC #	PBC Title	2009/10	2009/10	2010/11	2010/11	2011/12	2011/12	2012/13	2012/13
		Outcome	Expenditure	Outcome	Expenditure	Outcome	Expenditure	Outcome	Expenditure
1	Infectious diseases	Tests		Tests		Tests			
2	Cancers and tumours		Prior (A)			Tests			
3	Diseases of the blood	n/a	Prior (A)	n/a	Prior (A)	n/a			
4	Endocrine, nutritional, metabolic	Tests		Tests	Prior (B)		Tests		
5	Mental health disorders	n/a		n/a		n/a			
6	Learning disability	n/a	Tests	n/a	Priors (A, C)	n/a	Tests, prior (C)		
7	Neurological problems	Prior		Tests	Priors (A, B)	Tests, prior	Prior (C)		
8	Vision problems	n/a	Priors (A, C)	n/a		n/a			
9	Hearing problems	n/a	Priors (A, C)	n/a		n/a	Prior (B)		
10	Circulatory problems				Prior (A)				
11	Respiratory problems	Tests		Tests	Prior (A)		Tests		
12	Dental problems	n/a	Tests	n/a	Tests, priors (B, C)	n/a	Tests, priors (A, C)		
13	Gastro-intestinal problems	Tests		Tests	Prior (A)	Tests	Tests		
14	Skin problems	n/a	Tests	n/a	Prior (C)	n/a	Tests		
15	Musculo-skeletal problems	n/a	Prior (A)	n/a	Prior (A)	n/a	Prior (B)		
16	Trauma and injuries	n/a*		n/a*	Tests	Prior	Prior (C)		
17	Genito-urinary problems	Prior		Tests, prior	Prior (C)	Tests			
18	Maternity and reproductive health								
19	Neonates	Tests		Prior			Tests		
20	Poisoning and adverse events	n/a		n/a	Tests, prior (A)	n/a			
21	Healthy individuals	n/a		n/a	Prior (C)	n/a			
22	Social care needs	n/a	Prior (C)	n/a		n/a			
23	Other (includes GMS/PMS)	n/a	Priors (B, C)	n/a		n/a	Tests		
	*no preferred specification from previous year								
Totals	Pass (= blank cell)	n=2	n=12	n=2	n=8	n=4	n=10		
	Tests	n=5	n=3	n=5	n=1	n=4	n=6		
	Prior (negative coefficient on expenditure)	n=2		n=1		n=1			
	Tests and priors	n=0	n=0	n=1	n=2	n=1	n=2		
	Prior (A: 'significant', +ve coefficient on budget)		n=3		n=5		n=0		
	Prior (B: no significant +ve coefficient on o/need)		n=0		n=1		n=2		
	Prior (C: other coefficients significant)		n=1		n=3		n=2		
	Priors (A, B)		n=0		n=1				
	Priors (A, C)		n=2		n=1				
	Priors (B, C)		n=1						

Table A3 OLS specification for previous year and current year

		2009/10	2010/11	2011/12	2012/13
Number of times preferred specification is OLS and the same/similar OLS specification as in the previous year					
Outcome equation	(maximum n=10)	n=0	n=0	n=2	
Expenditure equation	(maximum n=22)	n=5	n=7	n=9	

In this section, Tables A4 and A5 provide details of our preferred specification for each outcome and expenditure model by PBC for 2011/12.

Table A4 Preferred outcome specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PBC 1	PBC 2	PBC 04	PBC 07	PBC 10	PBC 11	PBC 13	PBC 17	PBC 1819	PBC 16
	infectious	cancer	endocrine etc	neurological etc	circulatory	respiratory	gastro-intestinal	renal	mat/neonates	trauma/injuries
	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend
	SYLLR	SYLLR	SYLLR	SYLLR	SYLLR	SYLLR	SYLLR	SYLLR	infant m/rate	SMR<75 skull
	2011/12/13	2011/12/13	2011/12/13	2011/12/13	2011/12/13	2011/12/13	2011/12/13	2011/12/13	2011/12/13	fracture
	spend model	outcome model	outcome model	outcome model	outcome model	outcome model	outcome model	outcome model	outcome model	outcome model
	instrument n/a	spend	instrument n/a	spend	spend	spend	spend	instrument n/a	spend exogenous	spend exogenous
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	OLS	IV second stage	OLS	IV second stage	IV second stage	IV second stage	IV second stage	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 mortality	actual mortality	actual mortality	actual mortality
	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11
VARIABLES	Re-derived, OLS	10/11 version SI	10/11 version	Re-derived+	10/11 version	10/11 version	10/11 version DI	Re-derived, OLS	10/11 version	Re-derived, OLS
ILAg1_1112pheadOHP	-0.305*** [0.094]									
ILAhivneedph	0.172*** [0.049]									
ILAIMD2010	0.637*** [0.062]			0.402** [0.175]						
LLONEPENH11	-0.666*** [0.182]									
ILAg2_1112pheadOHP		-0.430*** [0.157]								
ILACARANneed1112		1.055*** [0.135]			2.452*** [0.295]		4.078*** [0.949]		1.989*** [0.377]	1.266*** [0.265]
ILAg4_1112pheadOHP			-0.199 [0.196]							
LPROFOCCU11			-1.041*** [0.147]							
LOWNOCC11			-0.555*** [0.139]							
ILAg7_1112pheadOHP				-1.415 [1.125]						
LWORKAGRI11				0.039 [0.051]						
ILAepiprev1112				1.271 [0.779]						
ILAg10_1112pheadOHP					-1.611*** [0.343]					
ILAg11_1112pheadOHP						-1.743*** [0.598]				
LPERMSICK11						6.198*** [1.592]				
LPERMSICK11SQ						0.727***				

ILAg13_1112pheadOHP						[0.220]				
							-2.000**			
ILACARANneed1112SQ							[0.984]			
							4.644***			
							[1.513]			
LWHITEEG11								-2.062***		
								[0.484]		
LNQUAL17411								1.246***		
								[0.461]		
ILAg17_1112pheadOHP								-0.494		
								[0.827]		
ILAg1819_1112phOHP									-0.136	
									[0.110]	
LBORNEXEU11									0.298***	
									[0.065]	
LHHNOCAR11									-0.357***	
									[0.106]	
ILAg16_1112pheadOHP										0.143
										[0.180]
Constant	-0.523	7.072***	0.581	12.713	12.292***	23.178***	11.964***	2.395	1.830***	-0.140
	[0.454]	[0.727]	[0.735]	[8.281]	[1.675]	[5.233]	[4.389]	[3.962]	[0.579]	[0.773]
Observations	145	148	147	148	148	148	148	148	147	149
R-squared	0.629		0.329					0.113	0.245	0.196
Ramsey reset F statistic	0.313		0.806					0.273	0.835	0.443
Probability > F	0.816		0.492					0.845	0.477	0.723
Endogeneity test statistic		9.404		2.857	25.774	14.703	10.016			
Endogeneity p-value		0.002		0.091	0.000	0.000	0.002			
Kleibergen-Paap LM test statistic		11.267		8.458	17.541	15.098	7.239			
Kleibergen-Paap p-value		0.001		0.004	0.000	0.000	0.007			
Kleibergen-Paap F statistic		14.773		8.746	17.472	18.118	9.678			
Pesaran-Taylor reset statistic		1.934		0.015	0.009	2.624	0.177			
Pesaran-Taylor p-value		0.380		0.902	0.925	0.105	0.674			
Hansen-Sargan test statistic					2.060					
Hansen-Sargan p-value					0.151					

Robust standard errors in brackets

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

Table A5 Preferred expenditure specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PBC 1	PBC 2	PBC 3	PBC 4	PBC 5	PBC 6	PBC 7	PBC 8	PBC 9
	infectious	cancer	Blood disorders	diabetes	Mental health	LDisability	epilepsy	Vision	hearing problems
	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend
	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13
	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model
	instrument n/a	instrument other needs	instrument n/a	instrument o/need	instrument n/a	instrument n/a	instrument o/need	instrument o/need	instrument n/a
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	OLS	IV second stage	OLS	IV second stage	OLS	OLS	IV second stage	IV second stage	OLS
	LA-level	GMM2S	LA-level	GMM2S	LA-level	LA-level	GMM2S	GMM2S	LA-level
	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality
	actual census 11	actual census11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11
VARIABLES	10/11 version	10/11 version	10/11 version	10/11 revised	10/11 version	Re-derived, OLS	10/11 revised	10/11 version	Re-derived,OLS2
ILAgall_1112pheadOHP	0.841*** [0.266]	0.961** [0.384]	0.876*** [0.248]	1.116*** [0.133]	1.194*** [0.212]	0.741* [0.398]	0.703*** [0.177]	1.279*** [0.241]	1.231*** [0.395]
ILAhivneedph	0.409*** [0.016]								
lacsyllrexIP1113	0.115 [0.207]								
ILAhivneedphSQ	0.075*** [0.023]								
lacsyllrexncancer1113		-1.414*** [0.292]							
ILACARANneed1112		1.323*** [0.423]							
LPROFOCCU11		-0.394*** [0.146]				-0.691*** [0.251]			-0.280 [0.281]
lacmSYLLR1113			0.060 [0.175]		-0.078 [0.121]	-0.042 [0.502]		-1.090*** [0.246]	0.376 [0.345]
LBORNEXEU11			0.178*** [0.026]						
lacsyllrexDIAB1113				-0.415*** [0.122]					
LNQUAL17411				0.275*** [0.065]				0.622*** [0.079]	
LWHITEEG11				-0.221*** [0.044]					
ILAmhneedindexpp					0.338** [0.147]				
LPOPPUCAR11					-0.496*** [0.120]				
LPC74LTUN11						-0.609*** [0.187]			
lacsyllrexEPI1113							-0.164 [0.146]		
ILAepiprev1112							0.531*** [0.081]		
LOWNOCC11									0.665*** [0.209]

Constant	-3.654*** [1.391]	4.919* [2.611]	-3.419*** [1.204]	-1.452* [0.825]	-4.244** [1.920]	-5.250 [3.403]	2.711** [1.098]	1.685* [0.920]	-9.391*** [2.474]
Observations	146	148	148	148	148	137	148	148	148
R-squared	0.773		0.367		0.732	0.128			0.306
Ramsey reset F statistic	1.018		0.705		0.108	0.371			0.594
Probability > F	0.387		0.551		0.955	0.774			0.620
Endogeneity test statistic		18.153		11.094			8.472	9.649	
Endogeneity p-value		0.000		0.001			0.004	0.002	
Hansen-Sargan test statistic		0.103		2.194			1.223	0.023	
Hansen-Sargan p-value		0.748		0.334			0.269	0.879	
Kleibergen-Paap LM test statistic		19.717		34.180			33.862	22.743	
Kleibergen-Paap p-value		0.000		0.000			0.000	0.000	
Kleibergen-Paap F statistic		18.612		66.387			117.471	19.191	
Pesaran-Taylor reset statistic		0.337		2.356			0.250	0.028	
Pesaran-Taylor p-value		0.562		0.125			0.617	0.866	

Robust standard errors in brackets

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

Table A5 continued Preferred expenditure specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PBC 10	PBC 11	PBC 12	PBC 13	PBC 14	PBC 15	PBC 16	PBC 17	PBC 1819
	circulatory	respiratory	dental problems	gastro problems	skin problems	musculo-skeletal	trauma/injuries	renal	maternity/neonates
	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend
	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13
	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model	spend model
	instrument o/need	instrument o/need	instrument o/need	instrument o/need	instrument o/need	instrument n/a	instrument n/a	instrument n/a	instrument n/a
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	IV second stage	IV second stage	IV second stage	IV second stage	IV second stage	OLS	OLS	OLS	OLS
	GMM2S	GMM2S	GMM2S	GMM2S	GMM2S				
	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 census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11
VARIABLES	10/11 version	10/11 revised	Re-derived+	10/11 version+	10/11 version+	10/11 version+	10/11 version+	10/11 version	10/11 version OLS
lacsyllrexresp1113		-0.722*** [0.213]							
ILAgall_1112pheadOHP	1.491*** [0.234]	1.360*** [0.177]	0.843*** [0.181]	1.033*** [0.210]	0.681*** [0.225]	0.456** [0.222]	1.024*** [0.193]	0.598*** [0.124]	0.481*** [0.180]
LNQUAL17411	0.414*** [0.083]	0.392*** [0.074]		0.361*** [0.065]		0.151 [0.106]			
ILACARANneed1112SQ		2.439*** [0.562]	-1.260 [0.789]	1.173** [0.541]					
lacsyllrexcirc1113	-1.202*** [0.236]								
lacmSYLLR1113			0.107 [0.300]		-0.259 [0.263]	0.215 [0.132]	-0.154 [0.135]		-0.217 [0.143]
ILAIMD2010			-0.080 [0.081]			0.172 [0.114]			
LPROFOCCU11			-0.194 [0.122]						
lacsyllrexgast1113				-0.593** [0.254]					
LPC74LTUN11					0.248** [0.099]	-0.226*** [0.077]			
LWHITEEG11					0.215*** [0.077]			-0.124*** [0.046]	
LOWNOCC11						0.513*** [0.113]			
LHHNOCAR11							-0.147*** [0.045]		
lacsyllrexrenal1113								0.088 [0.096]	
ILAmatneedindexpp									1.108*** [0.099]
Constant	1.354 [1.022]	-0.873 [0.777]	-2.750* [1.531]	0.802 [0.834]	1.193 [1.652]	-1.132 [1.368]	-2.656** [1.111]	-0.550 [0.563]	2.147** [0.858]

Observations	148	148	148	148	145	148	148	148	148
R-squared						0.499	0.242	0.434	0.601
Endogeneity test statistic	22.129	15.086	1.201	6.134	1.993				
Endogeneity p-value	0.000	0.000	0.273	0.013	0.158				
Hansen-Sargan test statistic	0.892	0.027	1.361		1.197				
Hansen-Sargan p-value	0.345	0.870	0.243		0.274				
Kleibergen-Paap LM test statistic	20.617	22.588	24.305	29.448	25.703				
Kleibergen-Paap p-value	0.000	0.000	0.000	0.000	0.000				
Kleibergen-Paap F statistic	19.918	19.840	51.658	94.008	35.963				
Pesaran-Taylor reset statistic	0.545	0.836	2.153	0.127	0.000				
Pesaran-Taylor p-value	0.460	0.360	0.142	0.722	0.992				
Ramsey reset F statistic						1.326	0.561	0.514	1.711
Probability > F						0.268	0.642	0.673	0.168

Robust standard errors in brackets

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

Table A5 continued Preferred expenditure specifications for 2011/12

	(1)	(2)	(3)	(4)
	PBC 20 poisoning 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	PBC 21 HI 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	PBC 22 social care 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	PBC 23a GMS 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version +
lacmSYLLR1113	-0.206 [0.286]	0.570 [0.388]	-0.698* [0.400]	-0.096 [0.103]
ILAgall_1112pheadOHP	0.631** [0.297]	1.748*** [0.515]	1.859*** [0.532]	0.518*** [0.113]
LNQUAL17411	0.298*** [0.090]	-0.008 [0.240]		
LPROFOCCU11				-0.186*** [0.065]
Constant	-0.147 [1.023]	-12.970*** [3.136]	-5.898** [2.922]	1.496** [0.719]
Observations	148	147	102	148
R-squared		0.319	0.121	0.430
Endogeneity test statistic	1.908			
Endogeneity p-value	0.167			
Hansen-Sargan test statistic	0.020			
Hansen-Sargan p-value	0.887			
Kleibergen-Paap LM test statistic	22.743			
Kleibergen-Paap p-value	0.000			
Kleibergen-Paap F statistic	19.191			
Pesaran-Taylor reset statistic	0.753			
Pesaran-Taylor p-value	0.385			
Ramsey reset F statistic		0.458	0.864	1.273
Probability > F		0.712	0.462	0.286

Robust standard errors in brackets

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

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 2011/12. For each PBC, we first estimate the model for 2011/12 using our preferred specification for 2010/11. 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 2011/12 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 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PBC 1	PBC 1	PBC 1	PBC 2	PBC 2	PBC 04	PBC 07	PBC 07
	infectious diseases	infectious diseases	infectious	cancer	cancer	endocrine etc	neurological etc	neurological etc
	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend
	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13
	outcome model	outcome model	spend model	outcome model	outcome model	outcome model	outcome model	outcome model
	instrument spend	instrument spend	instrument n/a	instrument spend	instrument spend	instrument n/a	instrument spend	instrument spend
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	IV second stage	IV second stage	OLS	IV second stage	IV second stage	OLS	IV second stage	IV second stage
	GMM2S	GMM2S		GMM2S	GMM2S		GMM2S	GMM2S
	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 census 11	actual census 11	actual census 11	actual census11	actual census11	actual census 11	actual census 11	actual census 11
VARIABLES	10/11 version	Re-derived	Re-derived, OLS	10/11 version	10/11 version SI	10/11 version	10/11 version	Re-derived+
ILAg1_1112pheadOHP	-0.307	-0.222	-0.305***					
	[0.389]	[0.232]	[0.094]					
ILAhivneedph	0.278*	0.144*	0.172***					
	[0.143]	[0.085]	[0.049]					
ILAIMD2010	0.644***	0.608***	0.637***					0.402**
	[0.144]	[0.098]	[0.062]					[0.175]
LLONEPENH11		-0.660***	-0.666***					
		[0.182]	[0.182]					
ILAg2_1112pheadOHP				-0.442***	-0.430***			
				[0.167]	[0.157]			
ILACARANneed1112				1.044***	1.055***		0.514	
				[0.144]	[0.135]		[0.603]	
ILAg4_1112pheadOHP						-0.199		
						[0.196]		
LPROFOCCU11						-1.041***		
						[0.147]		
LOWNOCC11						-0.555***		
						[0.139]		
ILAg7_1112pheadOHP							0.390	-1.415
							[0.561]	[1.125]
LWORKAGRI11								0.039
								[0.051]
ILAepiprev1112								1.271
								[0.779]

Constant	0.916 [0.922]	-0.700 [0.586]	-0.523 [0.454]	7.127*** [0.772]	7.072*** [0.727]	0.581 [0.735]	-0.393 [2.454]	12.713 [8.281]
Observations	145	145	145	148	148	147	148	148
Endogeneity test statistic	0.003	0.134		10.949	9.404		0.001	2.857
Endogeneity p-value	0.956	0.714		0.001	0.002		0.971	0.091
Hansen-Sargan test statistic	1.336			1.979				
Hansen-Sargan p-value	0.248			0.160				
Kleibergen-Paap LM test statistic	9.053	15.096		11.440	11.267		8.051	8.458
Kleibergen-Paap p-value	0.011	0.000		0.003	0.001		0.005	0.004
Kleibergen-Paap F statistic	4.820	25.198		7.343	14.773		12.170	8.746
Pesaran-Taylor reset statistic	2.380	0.414		0.024	1.934		0.224	0.015
Pesaran-Taylor p-value	0.123	0.520		0.876	0.380		0.636	0.902
R-squared			0.629			0.329		
Ramsey reset F statistic			0.313			0.806		
Probability > F			0.816			0.492		

Robust standard errors in brackets

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

Table A6 continued Estimation path to preferred outcome specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PBC 10	PBC 11	PBC 13	PBC 13	PBC 17	PBC 17	PBC 17	PBC 1819	PBC 16
	circulatory	respiratory	gastro-intestinal	gastro-intestinal	genito-urinary	genito-urinary	renal	mat/neonates	trauma/injuries
	2011/12 spend	2011/12 spend							
	SYLLR 2011/12/13	infant mort rate 2011/12/13	SMR<75 skull						
	outcome model	fracture							
	instrument spend	instrument n/a	spend exogenous	spend exogenous					
	weighted	weighted							
	IV second stage	OLS	OLS	OLS					
	GMM2S	GMM2S	GMM2S	GMM2S	GMM2S	GMM2S			
	LA-level	LA-level							
	actual mortality	actual mortality							
	actual census 11	actual census 11							
VARIABLES	10/11 version	10/11 version	10/11 version	10/11 version DI	10/11 version	Re-derived	Re-derived, OLS	10/11 version	10/11 version & Re-derived, OLS
ILAg11_1112pheadOHP		-1.743*** [0.598]							
LPERMSICK11		6.198*** [1.592]							
LPERMSICK11SQ		0.727*** [0.220]							
ILAg10_1112pheadOHP	-1.611*** [0.343]								
ILACARANneed1112	2.452*** [0.295]		4.222*** [1.030]	4.078*** [0.949]				1.989*** [0.377]	1.266*** [0.265]
ILAg13_1112pheadOHP			-2.154** [1.049]	-2.000** [0.984]					
ILACARANneed1112SQ			4.746*** [1.520]	4.644*** [1.513]					
ILAg17_1112pheadOHP					-1.796 [2.050]	-0.359 [1.513]	-0.494 [0.827]		
LPOPPUCAR11					0.027 [1.201]				
LWHITEEG11					-2.419*** [0.778]	-2.041*** [0.606]	-2.062*** [0.484]		
LNQUAL17411					1.655** [0.836]	1.174** [0.595]	1.246*** [0.461]		
ILAg1819_1112phOHP								-0.136 [0.110]	
LBORNEXEU11								0.298*** [0.065]	
LHHNOCAR11								-0.357*** [0.106]	
ILAg16_1112pheadOHP									0.143 [0.180]
Constant	12.292*** [1.675]	23.178*** [5.233]	12.649*** [4.681]	11.964*** [4.389]	8.783 [10.295]	1.693 [7.310]	2.395 [3.962]	1.830*** [0.579]	-0.140 [0.773]
Observations	148	148	148	148	148	148	148	147	149
R-squared							0.113	0.245	0.196

Endogeneity test statistic	25.774	14.703	9.935	10.016	0.490	0.018			
Endogeneity p-value	0.000	0.000	0.002	0.002	0.484	0.893			
Hansen-Sargan test statistic	2.060								
Hansen-Sargan p-value	0.151								
Kleibergen-Paap LM test statistic	17.541	15.098	4.711	7.239	15.847	32.037			
Kleibergen-Paap p-value	0.000	0.000	0.030	0.007	0.000	0.000			
Kleibergen-Paap F statistic	17.472	18.118	5.887	9.678	21.988	35.219			
Pesaran-Taylor reset statistic	0.009	2.624	0.151	0.177	0.310	0.487			
Pesaran-Taylor p-value	0.925	0.105	0.697	0.674	0.578	0.485			
Ramsey reset F statistic							0.273	0.835	0.443
Probability > F							0.845	0.477	0.723

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table A7 Estimation path to preferred expenditure specifications for 2011/12

	(1) PBC 1 infectious 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	(2) PBC 2 cancer 2011/12 spend SYLLR 2011/12/13 spend model instrument other needs weighted IV second stage GMM2S LA-level actual mortality actual census11 10/11 version	(3) PBC 3 Blood disorders 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	(4) PBC 4 diabetes 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	(5) PBC 4 diabetes 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 revised	(6) PBC 5 Mental health 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	(7) PBC 6 LDisability 2010/11 spend SYLLR 2010/11/12 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 10 10/11 version	(8) PBC 6 LDisability 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 Re-derived	(9) PBC 6 LDisability 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 Re-derived, OLS	(10) PBC 7 epilepsy 2011/12 spend all cause SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	(11) PBC 7 epilepsy 2011/12 spend all cause SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 revised
ILAgall_1112pheadOHP	0.841*** [0.266]	0.961** [0.384]	0.876*** [0.248]	1.118*** [0.137]	1.116*** [0.133]	1.194*** [0.212]	0.487 [0.635]	0.697 [0.463]	0.741* [0.398]	0.770*** [0.200]	0.703*** [0.177]
ILAhivneedph	0.409*** [0.016]										
lacsyllrexIP1113	0.115 [0.207]										
ILAhivneedphSQ	0.075*** [0.023]										
lacsyllrex1113		-1.414*** [0.292]									
ILACARANneed1112		1.323*** [0.423]									
LPROFOCCU11		-0.394*** [0.146]						-0.624 [0.533]	-0.563** [0.261]	-0.691*** [0.251]	
lacmSYLLR1113			0.060 [0.175]			-0.078 [0.121]	0.171 [1.030]	0.309 [0.583]	-0.042 [0.502]		
LBORNEXEU11			0.178*** [0.026]								
lacsyllrexDIAB1113				-0.415*** [0.121]	-0.415*** [0.122]						
LNQUAL17411				0.258 [0.424]	0.275*** [0.065]						
LNQUAL17411SQ				-0.005 [0.133]							
LWHITEG11				-0.221*** [0.044]	-0.221*** [0.044]			0.037 [0.413]			
ILAmhneedindexpp						0.338** [0.147]					
LPOPPUCAR11						-0.496*** [0.120]					
LLONEPENH11							0.411 [0.478]			-0.209 [0.184]	
LWORKAGRI11							-0.050 [0.057]				
LPC74LTUN11							-0.618** [0.288]	-0.653*** [0.183]	-0.609*** [0.187]	-0.145* [0.085]	

lacsyllrexEPI1113										-0.057	-0.164
										[0.290]	[0.146]
ILAepiprev1112										0.618***	0.531***
										[0.201]	[0.081]
Constant	-3.654***	4.919*	-3.419***	-1.480	-1.452*	-4.244**	-4.012	-7.084**	-5.250	0.949	2.711**
	[1.391]	[2.611]	[1.204]	[1.039]	[0.825]	[1.920]	[4.329]	[3.082]	[3.403]	[2.055]	[1.098]
Observations	146	148	148	148	148	148	137	137	137	148	148
R-squared	0.773		0.367			0.732			0.128		
Ramsey reset F statistic	1.018		0.705			0.108			0.371		
Probability > F	0.387		0.551			0.955			0.774		
Endogeneity test statistic		18.153		12.000	11.094		0.082	0.217		3.374	8.472
Endogeneity p-value		0.000		0.001	0.001		0.774	0.641		0.066	0.004
Hansen-Sargan test statistic		0.103		2.207	2.194		0.087	2.352		0.012	1.223
Hansen-Sargan p-value		0.748		0.332	0.334		0.768	0.503		0.914	0.269
Kleibergen-Paap LM test statistic		19.717		34.218	34.180		17.883	27.000		25.278	33.862
Kleibergen-Paap p-value		0.000		0.000	0.000		0.000	0.000		0.000	0.000
Kleibergen-Paap F statistic		18.612		74.860	66.387		13.982	31.160		24.411	117.471
Pesaran-Taylor reset statistic		0.337		2.937	2.356		0.004	0.790		0.321	0.250
Pesaran-Taylor p-value		0.562		0.087	0.125		0.951	0.374		0.571	0.617

Robust standard errors in brackets

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

Table A7 continued Estimation path to preferred expenditure specifications for 2011/12

	(1) PBC 8 Vision 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	(2) PBC 9 hearing problems 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	(3) PBC 9 hearing problems 2011/12 spend SYLLR 2011/12/13 outcome model instrument spend weighted IV second stage GMM2S LA-level actual mortality actual census 11 Re-derived	(4) PBC 9 hearing problems 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 Re-derived, OLS1	(5) PBC 9 hearing problems 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 Re-derived, OLS2	(6) PBC 10 circulatory 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	(7) PBC 11 respiratory 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	(8) PBC 11 respiratory 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 revised	(9) PBC 12 dental problems 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	(10) PBC 12 dental problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 Re-derived	(11) PBC 12 dental problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 Re-derived+
lacmSYLLR1113	-1.090*** [0.246]	0.643** [0.295]	0.880** [0.384]	0.469 [0.317]	0.376 [0.345]				0.185 [0.144]	0.470** [0.192]	0.107 [0.300]
lIAGall_1112pheadOHP	1.279*** [0.241]	1.301*** [0.385]	1.068** [0.440]	1.132** [0.438]	1.231*** [0.395]	1.491*** [0.234]	1.430*** [0.206]	1.360*** [0.177]	0.277 [0.243]	0.714*** [0.170]	0.843*** [0.181]
LNQUAL17411	0.622*** [0.079]			0.239 [0.253]		0.414*** [0.083]	0.367*** [0.082]	0.392*** [0.074]			
LOWNOCC11		0.745*** [0.211]	0.749*** [0.203]	0.579** [0.256]	0.665*** [0.209]						
LPROFOCCU11					-0.280 [0.281]						-0.194 [0.122]
lacsyllrexcirc1113						-1.202*** [0.236]					
lacsyllrexp1113							-0.779*** [0.245]	-0.722*** [0.213]			
ILACARANneed1112SQ								2.439*** [0.562]		-1.670** [0.738]	-1.260 [0.789]
ILACARANneed1112									0.527 [0.343]		
LLONEPENH11									0.005 [0.078]		
ILAIMD2010										-0.103 [0.078]	-0.080 [0.081]
Constant	1.685* [0.920]	-11.164*** [1.774]	-10.862*** [1.733]	-8.587*** [3.235]	-9.391*** [2.474]	1.354 [1.022]	-1.051 [0.894]	-0.873 [0.777]	0.980 [1.942]	-3.683*** [1.341]	-2.750* [1.531]
Observations	148	148	148	148	148	148	148	148	148	148	148
R-squared		0.300		0.305	0.306				0.436		
Endogeneity test statistic	9.649		1.433			22.129	16.922	15.086		0.026	1.201
Endogeneity p-value	0.002		0.231			0.000	0.000	0.000		0.871	0.273
Hansen-Sargan test statistic	0.023		0.416			0.892	0.056	0.027		3.467	1.361
Hansen-Sargan p-value	0.879		0.937			0.345	0.812	0.870		0.177	0.243
Kleibergen-Paap LM test statistic	22.743		40.925			20.617	21.348	22.588		32.555	24.305
Kleibergen-Paap p-value	0.000		0.000			0.000	0.000	0.000		0.000	0.000
Kleibergen-Paap F statistic	19.191		82.247			19.918	17.316	19.840		60.862	51.658
Pesaran-Taylor reset statistic	0.028		0.330			0.545	12.697	0.836		0.056	2.153
Pesaran-Taylor p-value	0.866		0.566			0.460	0.000	0.360		0.812	0.142

Ramsey reset F statistic	0.478	0.455	0.594	3.235
Probability > F	0.698	0.714	0.620	0.024

Robust standard errors in brackets

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

Table A7 continued Estimation path to preferred expenditure specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PBC 13	PBC 13	PBC 14	PBC 14	PBC 14	PBC 15	PBC 15	PBC 16	PBC 16
	gastro problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	gastro problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version+	skin problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version	skin problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version+	skin problems 2011/12 spend SYLLR 2011/12/13 spend model instrument o/need weighted IV second stage GMM2S LA-level actual mortality actual census 11 10/11 version+	musculo-skeletal 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	musculo-skeletal 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version+	trauma/injuries 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version	trauma/injuries 2011/12 spend SYLLR 2011/12/13 spend model instrument n/a weighted OLS LA-level actual mortality actual census 11 10/11 version+
VARIABLES	10/11 version	10/11 version+	10/11 version	10/11 version+	10/11 version+	10/11 version	10/11 version+	10/11 version	10/11 version+
lacsyllrexgast1113	-0.649** [0.270]	-0.593** [0.254]							
lAgall_1112pheadOHP	1.093*** [0.228]	1.033*** [0.210]	0.521** [0.228]	0.713*** [0.234]	0.681*** [0.225]	0.601*** [0.183]	0.456** [0.222]	1.008*** [0.191]	1.024*** [0.193]
LNQUAL17411	0.353*** [0.067]	0.361*** [0.065]				0.182* [0.104]	0.151 [0.106]		
lLACARANneed1112SQ		1.173** [0.541]							
lacmSYLLR1113			0.087 [0.229]	-0.195 [0.258]	-0.259 [0.263]	0.313** [0.134]	0.215 [0.132]	-0.154 [0.135]	-0.154 [0.135]
LPC74LTUN11			0.096 [0.083]	0.220** [0.096]	0.248** [0.099]	-0.148** [0.062]	-0.226*** [0.077]		
LBORNEXEU11			-0.025 [0.020]	0.040 [0.033]					
LWHITEEG11				0.325** [0.131]	0.215*** [0.077]				
LOWNOCC11						0.420*** [0.096]	0.513*** [0.113]		
lLAIMD2010							0.172 [0.114]		
LWORKAGRI11								0.003 [0.014]	
LHHNOCAR11								-0.136** [0.054]	-0.147*** [0.045]
Constant	0.695 [0.883]	0.802 [0.834]	-0.442 [1.598]	0.572 [1.616]	1.193 [1.652]	-1.971 [1.244]	-1.132 [1.368]	-2.516** [1.152]	-2.656** [1.111]
Observations	148	148	145	145	145	148	148	148	148
R-squared						0.492	0.499	0.242	0.242
Endogeneity test statistic	6.757	6.134	0.070	1.260	1.993				
Endogeneity p-value	0.009	0.013	0.791	0.262	0.158				
Kleibergen-Paap LM test statistic	28.261	29.448	29.817	26.152	25.703				
Kleibergen-Paap p-value	0.000	0.000	0.000	0.000	0.000				
Kleibergen-Paap F statistic	76.635	94.008	33.560	41.143	35.963				
Pesaran-Taylor reset statistic	3.629	0.127	0.152	0.065	0.000				
Pesaran-Taylor p-value	0.057	0.722	0.697	0.799	0.992				

Ramsey reset F statistic				1.704	1.326	0.566	0.561
Probability > F				0.169	0.268	0.639	0.642
Hansen-Sargan test statistic	7.789	2.351	1.197				
Hansen-Sargan p-value	0.020	0.125	0.274				

Robust standard errors in brackets

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

Table A7 continued Estimation path to preferred expenditure specifications for 2011/12

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PBC 17	PBC 1819	PBC 1819	PBC 20	PBC 21	PBC 22	PBC 23a	PBC 23a
	renal	maternity/neonates	maternity/neonates	poisoning	HI	social care	GMS	GMS
	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend	2011/12 spend
	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13	SYLLR 2011/12/13
	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 o/need	instrument n/a	instrument n/a	instrument n/a	instrument n/a
	weighted	weighted	weighted	weighted	weighted	weighted	weighted	weighted
	OLS	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
	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality	actual mortality
	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11	actual census 11
VARIABLES	10/11 version	10/11 version	10/11 version OLS	10/11 version	10/11 version	10/11 version	10/11 version	10/11 version +
LWHITEEG11	-0.124***							
	[0.046]							
lacsyllrexrenal1113	0.088							
	[0.096]							
lAgall_1112pheadOHP	0.598***	0.486**	0.481***	0.631**	1.748***	1.859***	0.537***	0.518***
	[0.124]	[0.219]	[0.180]	[0.297]	[0.515]	[0.532]	[0.120]	[0.113]
lacmSYLLR1113		-0.305	-0.217	-0.206	0.570	-0.698*	0.073	-0.096
		[0.194]	[0.143]	[0.286]	[0.388]	[0.400]	[0.096]	[0.103]
lAMatneedindexpp		1.214***	1.108***					
		[0.092]	[0.099]					
LNQUAL17411				0.298***	-0.008			
				[0.090]	[0.240]			
LPROFOCCU11								-0.186***
								[0.065]
Constant	-0.550	2.650***	2.147**	-0.147	-12.970***	-5.898**	0.548	1.496**
	[0.563]	[0.797]	[0.858]	[1.023]	[3.136]	[2.922]	[0.579]	[0.719]
Observations	148	148	148	148	147	102	148	148
R-squared	0.434		0.601		0.319	0.121	0.391	0.430
Ramsey reset F statistic	0.514		1.711		0.458	0.864	2.752	1.273
Probability > F	0.673		0.168		0.712	0.462	0.045	0.286
Endogeneity test statistic		0.123		1.908				
Endogeneity p-value		0.726		0.167				
Hansen-Sargan test statistic		5.992		0.020				
Hansen-Sargan p-value		0.050		0.887				
Kleibergen-Paap LM test statistic		31.137		22.743				
Kleibergen-Paap p-value		0.000		0.000				
Kleibergen-Paap F statistic		82.346		19.191				
Pesaran-Taylor reset statistic		0.722		0.753				
Pesaran-Taylor p-value		0.396		0.385				

Robust standard errors in brackets

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

Appendix 2: Expected health opportunity costs in the NHS (2011/12 results)

Overview

70. In the second appendix results are presented that reflect the available data for 2011/12 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

71. 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 Results for 2011/12 compared to previously generated results

Year	2008/09	2009/10	2010/11	2011/12
Cost per QALY	£13,095	£9,662	£10,750	£9,643
Health opportunity costs of £10mn (QALYs)	764	1,035	930	1037

72. It can be seen from Table A8 that the expected health opportunity costs of a given level of expenditure have increased between 2010/11 and 2011/12 and so the cost per QALY ratio has fallen. The associated uncertainty with each of these results is presented in Table A9 and figures A1 and A2 below.

Table A9 results for 2010/11 expenditure compared to previously generated results

2008/09	Point estimate	5th percentile	95th percentile
Cost per QALY	£13,095	£8,158	£38,652
Health opportunity costs of £10mn (QALYs)	764	259	1,226

2009/10	Point estimate	5th percentile	95th percentile
Cost per QALY	£9,662	£6,650	£16,784
Health opportunity costs of £10mn (QALYs)	1,035	596	1,504

2010/11	Point estimate	5th percentile	95th percentile
Cost per QALY	£10,750	£7,468	£18,298
Health opportunity costs of £10mn (QALYs)	930	547	1,339

2011/12	Point estimate	5th percentile	95th percentile
Cost per QALY	£9,643	£6,902	£15,290
Health opportunity costs of £10mn (QALYs)	1037	654	1,449

It can be seen from Table A9 that the expected health opportunity costs of a change in expenditure have increased slightly between 2009/10 and 2010/11 and so the cost per QALY ratio has fallen. The health opportunity costs of £10mn are greater than those estimated using 2008/9 data with the re-

applied specifications from the PCT model. 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 2011/12 and previously generated results – cost per QALY

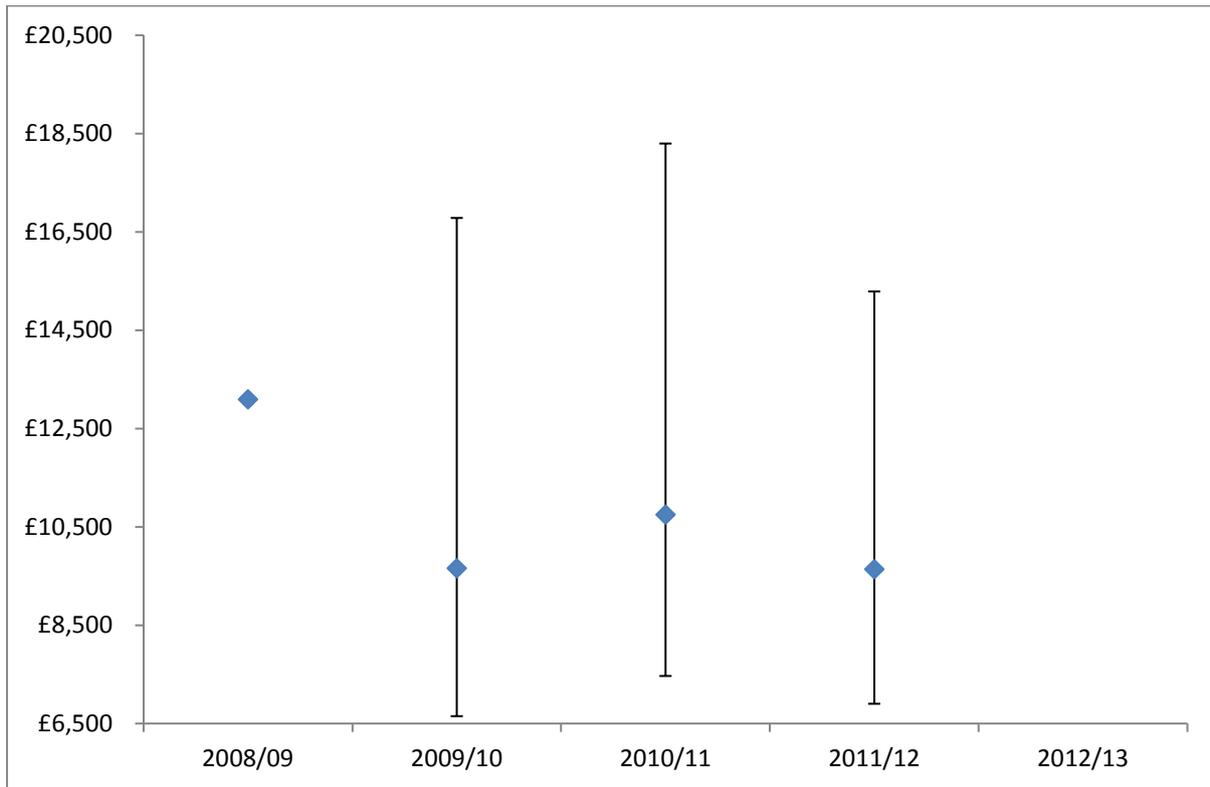
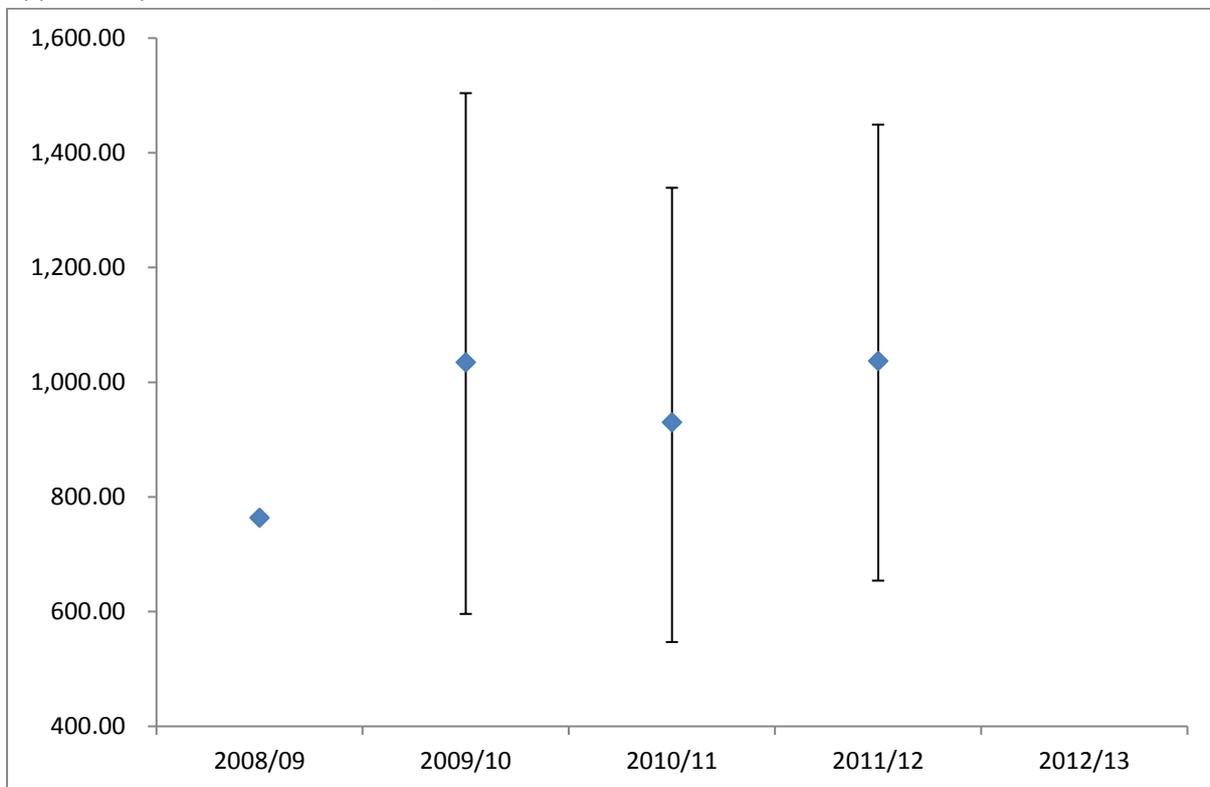


Figure A2 Results illustrating uncertainty for 2011/12 and previously generated results – Health opportunity costs of £10mn (QALYs)



73. The results contained within Table A9 are also represented graphically in Figures A1 and A2. The confidence intervals are presented for results pertaining to 2009/10 elasticities, 2010/11 elasticities and 2011/12 elasticities, but not for 2008/9 elasticities. The reason for this is that the specifications used for 2009/10, 2010/11 and 2010/11 equations were adjusted if a re-application of the previous year's specifications resulted in poor statistical performance (see Appendix 1). The specification of the 2008/9 models, however, were directly taken from Claxton et al. (2015) where there were two key differences: analysis was at PCT and not LA level and census variables used 2001 values not 2008 values (calculated by interpolation between 2001 and 2011 census data). As such, the specification in the 2008/9 models may not have passed all statistical performance tests once moved to LA level and the instruments were updated to 2008 values (e.g 2008/9 specification may possess weak instruments that lead to imprecise coefficient estimation).

74. 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).

Appendix 2.2 Sensitivity analysis

75. 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 A10 and A11.

Table A10 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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	47	£ 12,952.38	41	3.95%	5	8	7
10 Circulatory	£ 1,198,079.51	182	£ 6,582.53	105	10.09%	4	3	6
11 Respiratory	£ 696,859.54	315	£ 2,210.58	244	23.51%	2	1	2
13 Gastro-intestinal	£ 551,825.16	94	£ 5,851.88	129	12.40%	3	4	4
1 Infectious diseases	£ 144,840.00	3	£ 46,086.46	3	0.27%	8	7	8
4 Endocrine	£ 380,791.13	15	£ 26,211.12	34	3.23%	6	6	5
7 Neurological	£ 348,180.17	204	£ 1,710.05	350	33.71%	1	2	1
17 Genito-urinary	£ 320,948.55	2	£ 215,941.87	22	2.17%	7	5	3
16 Trauma & injuries*	£ 447,630.73	0	£ -	-	-	-	-	-
18+19 Maternity & neonates*	£ 251,898.81	0	£ 3,722,944.22	2	0.19%	9	9	9
3 Disorders of Blood	£ 116,655.70	15	£ 7,638.48	-	-	-	-	-
5 Mental Health	£ 1,547,128.19	103	£ 15,071.81	-	-	-	-	-
6 Learning Disability	£ 138,997.33	2	£ 59,456.35	-	-	-	-	-
8 Problems of Vision	£ 334,959.13	8	£ 43,175.92	-	-	-	-	-
9 Problems of Hearing	£ 66,350.25	14	£ 4,901.31	-	-	-	-	-
12 Dental problems	£ 334,337.22	10	£ 32,012.68	-	-	-	-	-
14 Skin	£ 164,918.76	2	£ 89,752.69	-	-	-	-	-
15 Musculo skeletal	£ 273,242.91	20	£ 13,946.23	-	-	-	-	-
20 Poisoning and AE	£ 71,335.67	1	£ 83,174.39	-	-	-	-	-
21 Healthy Individuals	£ 408,713.94	1	£ 408,841.37	-	-	-	-	-
22 Social Care Needs	£ 610,238.85	0	£ -	-	-	-	-	-
23 Other	£ 978,106.06	0	£ -	-	-	-	-	-

Total: 1,037

Table A11 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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	47	£ 12,952.38	23	2.26%	9	2	8
10 Circulatory	£ 1,198,079.51	182	£ 6,582.53	25	2.39%	6	6	3
11 Respiratory	£ 696,859.54	315	£ 2,210.58	67	6.49%	2	1	1
13 Gastro-intestinal	£ 551,825.16	94	£ 5,851.88	22	2.12%	10	10	9
1 Infectious diseases	£ 144,840.00	3	£ 46,086.46	10	0.95%	17	12	14
4 Endocrine	£ 380,791.13	15	£ 26,211.12	9	0.83%	18	11	12
7 Neurological	£ 348,180.17	204	£ 1,710.05	86	8.32%	1	19	2
17 Genito-urinary	£ 320,948.55	2	£ 215,941.87	16	1.52%	12	22	22
16 Trauma & injuries*	£ 447,630.73	0	£ -	23	2.26%	8	7	5
18+19 Maternity & neonates*	£ 251,898.81	0	£ 3,722,944.22	25	2.44%	5	5	4
3 Disorders of Blood	£ 116,655.70	15	£ 7,638.48	2	0.17%	22	20	20
5 Mental Health	£ 1,547,128.19	103	£ 15,071.81	21	1.98%	11	13	13
6 Learning Disability	£ 138,997.33	2	£ 59,456.35	13	1.25%	13	8	11
8 Problems of Vision	£ 334,959.13	8	£ 43,175.92	10	0.98%	15	16	16
9 Problems of Hearing	£ 66,350.25	14	£ 4,901.31	4	0.41%	21	18	19
12 Dental problems	£ 334,337.22	10	£ 32,012.68	10	1.00%	14	14	15
14 Skin	£ 164,918.76	2	£ 89,752.69	10	0.97%	16	15	17
15 Musculo skeletal	£ 273,242.91	20	£ 13,946.23	9	0.82%	19	21	21
20 Poisoning and AE	£ 71,335.67	1	£ 83,174.39	6	0.59%	20	17	18
21 Healthy Individuals	£ 408,713.94	1	£ 408,841.37	24	2.35%	7	9	10
22 Social Care Needs	£ 610,238.85	0	£ -	36	3.49%	4	4	6
23 Other	£ 978,106.06	0	£ -	44	4.27%	3	3	7

Total: 1,037

76. 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 A11, 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 1, 4, 3, 8, 9, 14, 15 and 20). This difference is not greater than 10% for any PBC. A significant change from the results for 2010/11 concerns PBC 7: neurological, the most important PBC in terms of spend elasticity in 2011/12 and 19th in 2010/11. This can be explained by the considerably lower implied PBC cost per QALY for PBC 7 in 2011/12 compared to 2010/11. Switching to look at Table A10 it can be seen that the most important PBC in terms of outcome elasticity sensitivity is PBC 7: neurological, as it is when spend elasticity is considered. The overall estimated health opportunity cost is also sensitive to PBC 11 (respiratory), although this is less important for sensitivity than PBC 7 because the outcome elasticity of PBC 11 is estimated with greater precision. PBCs that account for a large proportion of the change in spend also show high sensitivity to the outcome elasticity as would be expected (PBCs 10 and 13, circulatory and gastro-intestinal problems respectively).

77. 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 A12.

Table A12 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) 2010/11	Importance of PBC (rank) 2009/10
2 Cancer	£ 613,962.37	44	3	-0.32%	12	18	16
10 Circulatory	£ 1,198,079.51	127	55	-5.29%	5	4	5
11 Respiratory	£ 696,859.54	17	299	-28.80%	1	1	2
13 Gastro-intestinal	£ 551,825.16	36	58	-5.62%	4	3	6
1 Infectious diseases	£ 144,840.00	1	2	-0.23%	13	14	14
4 Endocrine	£ 380,791.13	1	14	-1.32%	8	9	4
7 Neurological	£ 348,180.17	7	197	-18.97%	2	5	1
17 Genito-urinary	£ 320,948.55	0	1	-0.11%	16	8	10
16 Trauma & injuries*	£ 447,630.73	0	0	0.00%	-	-	-
18+19 Maternity & neonates*	£ 251,898.81	0	0	0.00%	19	19	19
3 Disorders of Blood	£ 116,655.70	1	15	-1.47%	7	11	7
5 Mental Health	£ 1,547,128.19	9	94	-9.90%	3	2	3
6 Learning Disability	£ 138,997.33	1	2	-0.23%	14	12	15
8 Problems of Vision	£ 334,959.13	0	8	-0.75%	11	10	12
9 Problems of Hearing	£ 66,350.25	0	13	-1.31%	9	7	8
12 Dental problems	£ 334,337.22	0	10	-1.01%	10	13	11
14 Skin	£ 164,918.76	1	1	-0.18%	15	16	13
15 Musculo skeletal	£ 273,242.91	1	19	-1.89%	6	6	9
20 Poisoning and AE	£ 71,335.67	0	1	-0.08%	18	15	17
21 Healthy Individuals	£ 408,713.94	0	1	-0.10%	17	17	18
22 Social Care Needs	£ 610,238.85	0	0	0.00%	-	-	-
23 Other	£ 978,106.06	0	0	0.00%	-	-	-

Total: 245 792

Total change in QALY death + QALY alive 1,037

78. It can be seen that the surrogacy assumption is especially impactful for PBCs 7 and 11 (neurological and respiratory) while the assumption is only of negligible (<1%) importance for PBCs 1, 2, 17 and 18+19 (infectious diseases, cancer, genito-urinary and maternity & neonates). PBC 7 is more important in terms of sensitivity because of the much larger estimated outcome elasticity in 2011/12 compared to 2010/11. Extrapolation and surrogacy is particularly important for PBC 5 (mental health) and only negligibly important for PBCs 6, 8, 12, 14, 20 and 21 (learning disability, problems of vision, dental problems, skin, poisoning and AE and healthy individuals).

Appendix 2.3 Outline of ONS data update for 2011/12

79. 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 A13 Net YLL for 2008-2010, 2009-2011, 2010-2012 and 2011-2013 using LE for each PBC

2008-2010

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	80.1	84.0	80.1	84.0	5,262	39,656
2	83.4	85.1	83.4	85.1	131,945	1,369,741
4	81.4	85.1	81.4	85.1	6,763	51,348
7	80.1	83.7	80.1	83.7	16,771	93,096
10	83.4	86.8	83.4	86.8	151,443	778,237
11	80.7	84.4	80.7	84.4	64,449	85,785
13	81.0	84.9	81.0	84.9	23,898	230,841
17	83.9	85.9	83.9	85.9	11,345	15,635
18+19	79.3	83.5	79.3	83.5	265	19,907

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

2010-2012

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	80.7	84.5	80.7	84.5	4,721	36,662
2	83.8	85.5	83.8	85.5	134,236	1,405,256
4	81.9	85.5	81.9	85.5	6,348	50,182
7	80.7	84.1	80.7	84.1	18,312	91,923
10	83.8	87.2	83.8	87.2	136,790	741,406
11	81.3	84.8	81.3	84.8	64,034	99,150
13	81.6	85.3	81.6	85.3	23,325	232,162
17	84.3	86.3	84.3	86.3	9,876	15,325
18+19	80.0	83.9	80.0	83.9	234	17,773

2011-2013

PBC	GP LE (M)	GP LE (F)	PBC LE (M)	PBC LE (F)	All deaths	Net YLL
1	80.9	84.6	80.9	84.6	4,836	36,190
2	83.9	85.5	83.9	85.5	135,439	1,411,055
4	82.1	85.6	82.1	85.6	6,227	51,216
7	80.9	84.2	80.9	84.2	19,603	89,638
10	83.9	87.2	83.9	87.2	131,189	717,461
11	81.5	84.9	81.5	84.9	66,138	96,351
13	81.8	85.3	81.8	85.3	22,922	228,849
17	84.4	86.3	84.4	86.3	8,983	14,710
18+19	80.1	84.0	80.1	84.0	219	16,478