Costing methodology supporting Chapter 7.

Following previous research, GPs were identified using the following codes: senior partner; partner; associate; non-commercial local rota of less than 10 GPs; commercial deputising service; GP registrar; sole practitioner; and GP retainer. Nurses were identified using practice nurse; community-based nurse; hospital nurse; school nurse; and other nursing and midwifery. CPRD records listing administrative staff, such as secretaries, IT staff, practice and fund managers and receptionists, were not counted as a clinical direct contact with the patient and were, therefore, excluded from the costs.

We excluded from our costs tests that are routinely performed as part of a primary care consultation, such as blood pressure measurement, to avoid double counting. Pharmaceuticals were costed by matching each prescribed medication to a BNF code, moving from the most detailed level (subparagraph) to the top level (chapter) until a match was found. The number of medications per patient stratified by BNF code were then multiplied by the respective unit costs. The unit costs for each BNF code concerned the net ingredient cost per item prescribed reported in the Health and Social Care Information Centre Prescription Cost Analysis.

These were estimated using the average for each BNF level (from subparagraph to chapter) using the number of items prescribed as weights. Primary care costs were computed by multiplying the number of contacts/test/prescribed items by their unit costs. Costs per patient were then summed across these different resource categories and aggregated into monthly and annual amounts for the purposes of the analysis.

Supplementary Table 9.1. Primary care resource items and unit costs 2016/17

Resource item	CPRD definition	Unit cost 2016/17	Source
Consultations			
GP	Identified using role variable=1 2 3 4 5 6 7 8 10 35 47 50 60		
• GP at clinic	17.2min per appointment Identified using consultation type variable (constype)=1	£64	115
• GP at surgery	9.22min per appointment Constype=9 18 20 33 34 36 38 40	£34	115
• GP out of hours	9.22min per appointment Constype=2 3 4 6 11 24 27 28 30 31 32 37 50	£34	115
• GP out of office	23.4min per appointment Constype=2 3 4 6 11 24 27 28 30 31 32 37 50	£87	115
• GP telephone contact	7.1min per contact Constype=21 35 55	£26	115
Nurse	Role=11 13 36 38 45 54 61 62		

Resource item	CPRD definition	Unit cost 2016/17	Source
• Nurse at surgery	15.5min per appointment Constype=1 9 18 20 33 34 36 38 40	£11	[115]
• Nurse out of hours	15.5min per appointment Constype=2 3 4 6 11 24 27 28 30 31 32 37 50	£11	[115]
• Nurse out of office	Constype=2 3 4 6 11 24 27 28 30 31 32 37 50	£37	HRG: N02AF[116]
• Nurse telephone contact	7.1min per contact Constype=21 35 55	£17	HRG: N02AN[116]
Midwife	Role=14	£70	HRG: N01A[116]
Community psychiatric nurse	Role=15	£68	HRG: N29AF[116]
Health visitor	Role=12 30 37	£75	HRG: N03G[116]
Physiotherapist, chiropractor and osteopath	Role=26 31 42 43	£53	HRG: A08A1[116]
Chiropodist	Role=27	£41	HRG: A09A[116]
Dentist	Role=28 52	£154	HRG: M01A[116]
Dietitian	Role=29	£85	HRG: A03[116]
Speech therapist	Role=49	£96	HRG: A13A1[116]
Carer	Role=46	£26	[115]
Occupational therapist	Role=48	£79	HRG: A06A1[116]

Resource item	CPRD definition	Unit cost 2016/17	Source
Other	Assuming nurse cost Role=17 18 19 33 39 44 51 55 56 57 58 63 65 67 68	£11	[115]
Lab tests			
Asthma	Identified using Entity variable (enttype)= 307-311	£54	DZ45Z[116]
Haematology	Enttype=168 173 180 181 182 183 184 189 194 195 207 208 215 220 273 281 289 293 312 313 314 318 321 322 323 324 349 353 361 374 381 382 387 397 418 419 442 443	£3.06	DAPS05[116]

Resource item	CPRD definition	Unit cost 2016/17	Source
Clinical biochemistry	Enttype=151 152 153 155 156 157 158 159 160 161 162 163 164 165 166 167 169 170 172 171 174 175 176 177 178 179 185 186 187 188 190 191 192 193 196 197 198 199 200 201 202 203 204 205 206 210 213 214 216 222 223 225 232 233 236 239 272 274 275 276 277 285 286 287 315 331 332 333 334 335 336 338 340 344 345 352 354 355 356 362 363 365 366 369 373 375 376 377 383 384 390 391 400 406 414 415 423 424 429 430 431 432 433 434 435 445 446 447 449 454 456 437 438 439 440 441 450 451 455 458	£1.14	DAPS04[116]

Resource item	CPRD definition	Unit cost 2016/17	Source
Microbiology	Enttype=219 227 228 230 234 235 240 241 242 243 244 245 246 247 248 249 250 316 317 319 348 357 385 386 407 410 420 428 452	£7.50	DAPS07[116]
Cytology	Enttype=288 337 403 425	£14.49	DAPS01[116]
Serology and immunology	Enttype=221 231 270 271 278 279 280 282 283 290 291 292 325 326 327 328 329 330 346 347 359 360 364 370 388 389 405 421 422 436 453	£6.55	DAPS06[116]
Histology	Enttype=337	£35.55	DAPS02[116]
Other tests	Enttype=154 229	£2.52	DAPS09[116]
Diagnostic imaging			
CT scan	Enttype=299 444	£96	HRG: average of RD20A-RD28Z[116]
MRI scan	Enttype=300	£137	HRG: average of RD01A-RD07Z[116]
Nuclear medicine	Enttype=298	£249	HRG: average of all NM codes [116]
Ultrasound scan	Enttype=237 238 284 339	£52	HRG: average of RD40Z-RD48Z[116]

Resource item	CPRD definition	Unit cost 2016/17	Source
X-ray	Enttype= 226 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 341 358	£30	HRG: DAPF[116]
Bone density studies	Enttype=368	£80	HRG: RD50Z[116]
Fluoroscopy	Enttype=211 212 224 305 306 416	£124	HRG: average of RD30Z-RD32Z[116]
Venography/ Sialogram	Enttype=378 448	£153	HRG: YR26Z[116]
Other	Enttype=251	£69	HRG: average of all IMAG HRGs[116]
Diagnostic tests			
Nerve conduction studies	Enttype=217 343 404	£76	HRG: AA33C[116]
Endoscopy/ Duodenoscopy/ Oesophagoscopy	Enttype=218 295 408	£500	HRG: FE50A[116]
Bronchoscopy	Enttype=294	£423	HRG: DZ69A[116]
Colonoscopy	Enttype=296	£346	HRG: FE50A[116]
Sigmoidoscopy	Enttype=297	£185	HRG: average of FE34Z-FE35Z[116]
Doppler	Enttype=367	£65	HRG: RD47Z[116]
ECG exercise	Enttype=304 379	£52	HRG: EY51Z[116]
Echocardiogram	Enttype=342	£56	HRG: RD51A[116]

Multiple imputation of missing variables in the Knee replacement cohort

From a cohort of 394,118 individuals eligible to estimate the predictors of 1-year hospitalisation costs (i.e. complete follow up to 1 year or death), we excluded individuals with missing fixation data (n=324), anaesthesia data (n=2,103) and missing implantation type data (n=5,038). We then imputed the following missing variables using a chained model with 20 iterations for the remaining 386,653 individuals:

- Deformity (under 10^{o}, 10^{o} to 30^{o} and over 30^{o}: ordered logit)
- Range flexion ($<70^{o}$, 70^{o}-90^{o}, 91^{o} -110^{o} and over 110^{o}: ordered logit)
- Non-white ethnic group (logit regression)
- BMI at joint replacement (OLS regression)
- IMD score at joint replacement (OLS regression)
- Oxford Hip score at baseline (truncated regression between 0 and 48)
- Oxford Hip score change at 6 months (OLS regression)
- EQ5D score at baseline (truncated regression between -0.594 and 1)
- EQ5D score change at 6 months (OLS regression)

We regressed the missing variables on the following complete variables:

- Sex (binary)
- Age (continuous)
- ASA grade I, III and IV/V
- Charlson co-morbidity score (continuous)
- Fixation (categorical: cemented, uncemented, hybrid)
- Surgical approach (categorical: lateral parapatellar, medial parapatellar, mid-vastus, sub-vastus, other)
- Thrombolysis agents (categorical: none, aspirin, LMWH, other)
- Type of anaesthesia (binary variables for: general, epidural, nerve block and spinal)

- Complications within 1 year (binary)
- Revision within 1 year (binary)
- Death (binary)

Multiple imputation of missing variables in the Hip replacement cohort

From a cohort of 344,721 individuals eligible to estimate the predictors of 1-year hospitalisation costs (i.e. complete follow up to 1 year or death), we excluded individuals with missing anaesthesia data (n=1,865), missing head size data (n=8,229), missing bearing data (n=2,856) and missing cup fixation data (n=1,276). It was not possible to impute head size and bearing data together as several observations were completely determined by each other. We then imputed the following missing variables using a chained model with 20 iterations for the remaining 330,765 individuals:

- Non-white ethnic group (logit regression)
- BMI at joint replacement (OLS regression)
- IMD score at joint replacement (OLS regression)
- Oxford Hip score at baseline (truncated regression between 0 and 48)
- Oxford Hip score change at 6 months (OLS regression)
- EQ5D score at baseline (truncated regression between -0.594 and 1)
- EQ5D score change at 6 months (OLS regression)

We regressed the missing variables on the following complete variables:

- Sex (binary)
- Age (continuous)
- ASA grade I, III and IV/V
- Charlson co-morbidity score (continuous)
- Surgical approach (=1 other; 0= posterior)

- Bearing (categorical: MoM, MoP, CoC, CoP and other)
- Head size (categorical: 28 or under, 29 to 35, 36 to 42, 43 to 48, 49 to 52, and 53 and above)
- Thrombolysis agents (categorical: none, aspirin, LMWH, other)
- Type of anaesthesia (binary variables for: general, epidural, nerve block and spinal)
- Complications within 1 year (binary)
- Revision within 1 year (binary)
- Death (binary)