



Patient Reported Outcome Measures (PROMs) in England

*A Methodology for applying casemix adjustment
Annex C: Coefficients for Hip Replacement
Models*

Annex C: Coefficients for Hip Replacement models

Table C1 gives the variables that were statistically significant at the 95% level from the estimation step and their coefficients for predicting post-operative (Q2) scores for the Hip Replacement EQ-5D Index instrument¹.

Factor	Definition	Coefficient	Standard error
Q1 score	Patient's pre-operative questionnaire score	0.285	0.011
Q1 score (squared)	Patient's pre-operative questionnaire score, squared	-0.173	0.016
Age	Patient's age	0.006	0.0009
Age (squared)	Patient's age, squared	0.00004	0.000007
Sex: Female	Takes value 1 if patient is female, 0 if not	-0.017	0.002
Ethnicity: Asian	Takes value 1 if patient is of Asian ethnicity, 0 if not	-0.059	0.021
Ethnicity: Black	Takes value 1 if patient is of Black ethnicity, 0 if not	-0.056	0.017
Ethnicity: Not given	Takes value 1 if patient's ethnicity is not given through HES, 0 if not	0.023	0.004
IMD (Deprivation)	The IMD (Deprivation) 2004 score for the area the patient lives in	-0.001	0.0001
Assisted at Q1	Takes value 1 if patient was assisted in completing pre-operative questionnaire, 0 if not	0.013	0.003
Assisted at Q2	Takes value 1 if patient was assisted in completing post-operative questionnaire, 0 if not	-0.098	0.005
Disabled at Q1	Takes value 1 if patient considers themselves to have a disability, 0 if not	-0.066	0.002
HRG Code H80	Takes value 1 if the main HRG assigned to patient's spell was H80 (v3.5), 0 if not	0.056	0.025
HRG Code H81	Takes value 1 if the main HRG assigned to patient's spell was H81 (v3.5), 0 if not	0.065	0.025
Previous Surgery: Yes	Takes value 1 if patient has had previous surgery on their hip, 0 if not	-0.037	0.006
PRC: High blood pressure	Takes value 1 if patient has high blood pressure, 0 if not	0.017	0.004
PRC: Poor circulation	Takes value 1 if patient has poor circulation, 0 if not	-0.048	0.006
PRC: Diabetes	Takes value 1 if patient has diabetes, 0 if not	0.021	0.006
PRC: Nervous system diseases	Takes value 1 if patient has nervous system diseases, 0 if not	-0.050	0.013
PRC: Cancer	Takes value 1 if patient has (had) cancer, 0 if not	0.020	0.006
PRC: Depression	Takes value 1 if patient has depression, 0 if not	-0.103	0.006
PRC: Arthritis	Takes value 1 if patient has arthritis, 0 if not	-0.015	0.003

¹ Note:
 PRC = Patient Reported Comorbidity
 HESRC = HES Reported Comorbidity

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Patient has 1 HESRC	Takes value 1 if patient has one HES-reported comorbidity, 0 if not	-0.023	0.003
Patient has 2 HESRC	Takes value 1 if patient has two HES-reported comorbidities, 0 if not	-0.053	0.007
Patient has 3 HESRC	Takes value 1 if patient has three or more HES-reported comorbidities, 0 if not	-0.060	0.017
Patient has 2 PRCs	Takes value 1 if patient has self-reported exactly two comorbidities, 0 if not	-0.027	0.005
Patient has 3 PRCs	Takes value 1 if patient has self-reported exactly three comorbidities, 0 if not	-0.047	0.008
Patient has 4 PRCs	Takes value 1 if patient has self-reported four or more comorbidities, 0 if not	-0.080	0.014
Symptom period (1-5 yrs)	Takes value 1 if patient has experienced symptoms for between 1 and 5 years, 0 if not	-0.012	0.003
Symptom period (6-10 yrs)	Takes value 1 if patient has experienced symptoms for between 6 and 10 years, 0 if not	-0.028	0.005
Symptom period (10+ yrs)	Takes value 1 if patient has experienced symptoms for more than 10 years, 0 if not	-0.027	0.005
Constant term		0.562	0.040

Table C1: Descriptions and coefficients of variables included in the Hip Replacement EQ-5D Index statistical prediction model for PROMs case-mix adjustment

The predicted score is found by multiplying each coefficient by the patient's response, summing the values and adding the constant term i.e. the predicted Q2 score is calculated as:

$$\begin{aligned}
 Q2_{\text{predicted}} = & 0.285 * (Q1 \text{ Score}) - 0.173 * (Q1 \text{ score squared}) + 0.006 * \\
 & (Age) - 0.00004 * (Age \text{ squared}) - 0.017 * (Female) - 0.059 * (Asian) - 0.056 * \\
 & (Black) + 0.023 * (Eth \text{ Not Given}) - 0.001 * (IMD \text{ Score}) + 0.013 * (Assisted \\
 & Q1) - 0.098 * (Assisted Q2) - 0.066 * (Disabled Q1) + 0.056 * (HRG H80) + \\
 & 0.065 * (HRG H81) - 0.037 * (Yes \text{ Previous Surgery}) + 0.017 * (High BP) - \\
 & 0.048 * (Circulation) + 0.021 * (Diabetes) - 0.050 * (Nervous System) + 0.020 \\
 & * (Cancer) - 0.103 * (Depression) - 0.015 * (Arthritis) - 0.023 * (1 HES CoM) - \\
 & 0.053 * (2 HES CoM) - 0.060 * (3+ HES CoM) - 0.027 * (2 Self CoM) - 0.047 * \\
 & (3 Self CoM) - 0.080 * (4+ Self CoM) - 0.012 * (Symptom 1-5 yrs) - 0.028 * \\
 & (Symptom 6-10 yrs) - 0.027 * (Symptom 10+ yrs) + 0.562
 \end{aligned}$$

The key drivers in this model are:

- the patient's Q1 score,
- the patient's disability status,
- whether the patient has depression,
- whether the patient was assisted in completing their post-operative questionnaire, and
- their IMD deprivation score.

All the other factors included in the table above have a statistically significant impact on predicting post-operative scores (at a 5% level), but they are less influential in driving Q2 scores.

Hip Replacement – EQ-5D VAS

Table C2 gives the variables that were statistically significant at the 95% level from the estimation step and their coefficients for predicting post-operative (Q2) scores for the Hip Replacement EQ-5D VAS instrument.

Factor	Definition	Coefficient	Standard error
Q1 score	Patient's pre-operative questionnaire score	-0.046	0.018
Q1 score (squared)	Patient's pre-operative questionnaire score, squared	0.002	0.0002
Age	Patient's age	0.338	0.066
Age (squared)	Patient's age, squared	-0.003	0.0005
Sex: Female	Takes value 1 if patient is female, 0 if not	-0.568	0.172
Ethnicity: Mixed	Takes value 1 if patient is of Mixed ethnicity, 0 if not	-5.708	2.321
Ethnicity: Black	Takes value 1 if patient is of Black ethnicity, 0 if not	-2.755	1.289
Ethnicity: Not given	Takes value 1 if patient's ethnicity is not given through HES, 0 if not	1.733	0.317
IMD (Deprivation)	The IMD (Deprivation) 2004 score for the area the patient lives in	-0.087	0.007
Assisted at Q2	Takes value 1 if patient was assisted in completing post-operative questionnaire, 0 if not	-6.771	0.366
Disabled at Q1	Takes value 1 if patient considers themselves to have a disability, 0 if not	-4.692	0.182
HRG Code H80	Takes value 1 if the main HRG assigned to patient's spell was H80 (v3.5), 0 if not	3.965	1.862
HRG Code H81	Takes value 1 if the main HRG assigned to patient's spell was H81 (v3.5), 0 if not	4.804	1.864
Previous Surgery: Yes	Takes value 1 if patient has had previous surgery on their hip, 0 if not	-1.932	0.484
PRC: Heart disease	Takes value 1 if patient has heart disease, 0 if not	-1.369	0.390
PRC: High blood pressure	Takes value 1 if patient has high blood pressure, 0 if not	0.663	0.309
PRC: Poor circulation	Takes value 1 if patient has poor circulation, 0 if not	-3.465	0.441
PRC: Lung disease	Takes value 1 if patient has lung disease, 0 if not	-1.384	0.448
PRC: Diabetes	Takes value 1 if patient has diabetes, 0 if not	1.279	0.431
PRC: Nervous system diseases	Takes value 1 if patient has nervous system diseases, 0 if not	-6.894	0.956
PRC: Liver disease	Takes value 1 if patient has liver disease, 0 if not	-2.453	1.235
PRC: Depression	Takes value 1 if patient has depression, 0 if not	-5.463	0.425
PRC: Arthritis	Takes value 1 if patient has arthritis, 0 if not	-0.992	0.254
Patient has 1 HESRC	Takes value 1 if patient has one HES-reported comorbidity, 0 if not	-2.706	0.248
Patient has 2 HESRC	Takes value 1 if patient has two HES-reported comorbidities, 0 if not	-4.862	0.524
Patient has 3 HESRC	Takes value 1 if patient has three or more HES-reported comorbidities, 0 if not	-6.638	1.230
Patient has 2 PRCs	Takes value 1 if patient has self-reported exactly two comorbidities, 0 if not	-1.940	0.365

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Patient has 3 PRCs	Takes value 1 if patient has self-reported exactly three comorbidities, 0 if not	-3.294	0.622
Patient has 4 PRCs	Takes value 1 if patient has self-reported four or more comorbidities, 0 if not	-4.286	1.000
Symptom period (6-10 yrs)	Takes value 1 if patient has experienced symptoms for between 6 and 10 years, 0 if not	-0.675	0.338
Constant term		61.128	2.986

Table C2: Descriptions and coefficients of variables included in the Hip Replacement EQ-5D VAS statistical prediction model for PROMs case-mix adjustment

The predicted score is found by multiplying each coefficient by the patient's response, summing the values and adding the constant term i.e. the predicted Q2 score is calculated as:

$$\begin{aligned}
 Q2_{\text{predicted}} = & -0.046 * (Q1 \text{ score}) + 0.002 * (Q1 \text{ score squared}) + 0.338 * \\
 & (\text{Age}) - 0.003 * (\text{Age squared}) - 0.568 * (\text{Female}) - 5.708 * (\text{Mixed}) - 2.755 * \\
 & (\text{Black}) + 1.733 * (\text{Eth Not Given}) - 0.087 * (\text{IMD Score}) - 6.771 * (\text{Assisted} \\
 & \text{Q2}) - 4.692 * (\text{Disabled Q1}) + 3.965 * (\text{HRG H80}) + 4.804 * (\text{HRG H81}) - \\
 & 1.932 * (\text{Yes Previous Surgery}) - 1.369 * (\text{Heart Disease}) + 0.663 * (\text{High BP}) \\
 & - 3.465 * (\text{Circulation}) - 1.384 * (\text{Lung Disease}) + 1.279 * (\text{Diabetes}) - 6.894 * \\
 & (\text{Nervous System}) - 2.453 * (\text{Liver Disease}) - 5.463 * (\text{Depression}) - 0.992 * \\
 & (\text{Arthritis}) - 2.706 * (1 \text{ HES CoM}) - 4.862 * (2 \text{ HES CoM}) - 6.638 * (3+ \text{ HES} \\
 & \text{CoM}) - 1.940 * (2 \text{ Self CoM}) - 3.294 * (3 \text{ Self CoM}) - 4.2856 * (4+ \text{ Self CoM}) - \\
 & 0.675 * (\text{Symptom 6-10 yrs}) + 61.128
 \end{aligned}$$

As with the Hip Replacement EQ-5D Index model, the key drivers in this model are:

- the patient's Q1 score,
- the patient's disability status,
- whether the patient has depression,
- whether the patient was assisted in completing their post-operative questionnaire,
- the patient's deprivation score, and
- the number of HES reported comorbidities the patient has.

All the other factors included in the table above have a statistically significant impact on predicting post-operative scores (at a 5% level), but they are less influential in driving Q2 scores.

Hip Replacement – Oxford Hip Score

Table C3 gives the variables that were statistically significant at the 95% level from the estimation step and their coefficients for predicting post-operative (Q2) scores for the Hip Replacement Oxford Hip Score instrument.

Factor	Definition	Coefficient	Standard error
Q1 score	Patient's pre-operative questionnaire score	0.543	0.019
Q1 score (squared)	Patient's pre-operative questionnaire score, squared	-0.007	0.0005
Age	Patient's age	0.188	0.031
Age (squared)	Patient's age, squared	-0.002	0.0002
Sex: Female	Takes value 1 if patient is female, 0 if not	-0.751	0.082
Ethnicity: Asian	Takes value 1 if patient is of Asian ethnicity, 0 if not	-3.922	0.759
Ethnicity: Black	Takes value 1 if patient is of Black ethnicity, 0 if not	-4.249	0.593
Ethnicity: Not given	Takes value 1 if patient's ethnicity is not given through HES, 0 if not	1.073	0.150
IMD (Deprivation)	The IMD (Deprivation) 2004 score for the area the patient lives in	-0.061	0.003
Assisted at Q1	Takes value 1 if patient was assisted in completing pre-operative questionnaire, 0 if not	0.338	0.116
Assisted at Q2	Takes value 1 if patient was assisted in completing post-operative questionnaire, 0 if not	-2.489	0.171
Disabled at Q1	Takes value 1 if patient considers themselves to have a disability, 0 if not	-2.036	0.087
Procedure: THR revision	Takes value 1 if the principal procedure code ascribed to the patient is Total Hip Replacement: Revision, 0 if not	-1.086	0.540
HRG Code H81	Takes value 1 if the main HRG assigned to patient's spell was H81 (v3.5), 0 if not	1.903	0.889
Previous Surgery: Yes	Takes value 1 if patient has had previous surgery on their hip, 0 if not	-1.840	0.221
PRC: High blood pressure	Takes value 1 if patient has high blood pressure, 0 if not	0.521	0.145
PRC: Poor circulation	Takes value 1 if patient has poor circulation, 0 if not	-2.567	0.205
PRC: Diabetes	Takes value 1 if patient has diabetes, 0 if not	0.413	0.203
PRC: Nervous system diseases	Takes value 1 if patient has nervous system diseases, 0 if not	-1.122	0.458
PRC: Liver disease	Takes value 1 if patient has liver disease, 0 if not	-1.412	0.578
PRC: Cancer	Takes value 1 if patient has (had) cancer, 0 if not	0.875	0.222
PRC: Depression	Takes value 1 if patient has depression, 0 if not	-2.078	0.201
Patient has 2 HESRC	Takes value 1 if patient has two HES-reported comorbidities, 0 if not	-1.522	0.243
Patient has 3 HESRC	Takes value 1 if patient has three or more HES-reported comorbidities, 0 if not	-1.387	0.595
Patient has 2 PRCs	Takes value 1 if patient has self-reported exactly two comorbidities, 0 if not	-0.683	0.172
Patient has 3 PRCs	Takes value 1 if patient has self-reported exactly three comorbidities, 0 if not	-1.573	0.293

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Patient has 4 PRCs	Takes value 1 if patient has self-reported four or more comorbidities, 0 if not	-2.185	0.470
Symptom period (1-5 yrs)	Takes value 1 if patient has experienced symptoms for between 1 and 5 years, 0 if not	-0.606	0.113
Symptom period (6-10 yrs)	Takes value 1 if patient has experienced symptoms for between 6 and 10 years, 0 if not	-1.244	0.159
Symptom period (10+ yrs)	Takes value 1 if patient has experienced symptoms for more than 10 years, 0 if not	-1.439	0.176
Constant term		28.893	1.406

Table C3: Descriptions and coefficients of variables included in the Hip Replacement Oxford Hip Score statistical prediction model for PROMs case-mix adjustment

The predicted score is found by multiplying each coefficient by the patient's response, summing the values and adding the constant term i.e. the predicted Q2 score is calculated as:

$$\begin{aligned}
 Q2_{\text{predicted}} = & 0.543 * (Q1 \text{ score}) - 0.007 * (Q1 \text{ score squared}) + 0.188 * (\text{Age}) \\
 & - 0.002 * (\text{Age squared}) - 0.751 * (\text{Female}) - 3.922 * (\text{Asian}) - 4.249 * (\text{Black}) + \\
 & 1.073 * (\text{Eth Not Given}) - 0.061 * (\text{IMD Score}) + 0.338 * (\text{Assisted Q1}) - 2.489 \\
 & * (\text{Assisted Q2}) - 2.036 * (\text{Disabled Q1}) - 1.086 * (\text{Op Total Hip Revision}) + \\
 & 1.903 * (\text{HRG H81}) - 1.840 * (\text{Yes Previous Surgery}) + 0.521 * (\text{High BP}) - \\
 & 2.567 * (\text{Circulation}) + 0.413 * (\text{Diabetes}) - 1.122 * (\text{Nervous System}) - 1.412 * \\
 & (\text{Liver Disease}) + 0.875 * (\text{Cancer}) - 2.078 * (\text{Depression}) - 1.522 * (2 \text{ HES} \\
 & \text{CoM}) - 1.387 * (3+ \text{ HES CoM}) - 0.683 * (2 \text{ Self CoM}) - 1.573 * (3 \text{ Self CoM}) - \\
 & 2.185 * (4+ \text{ Self CoM}) - 0.606 * (\text{Symptom 1-5 yrs}) - 1.244 * (\text{Symptom 6-10} \\
 & \text{yrs}) - 1.439 * (\text{Symptom 10+ yrs}) + 28.893
 \end{aligned}$$

Similar to the Hip Replacement EQ-5D Index and the EQ-5D VAS model, the key drivers in this model are:

- the patient's Q1 score,
- the patient's disability status,
- whether the patient has depression,
- whether the patient was assisted in completing their post-operative questionnaire, and
- the patient's deprivation score.

All the other factors included in the table above have a statistically significant impact on predicting post-operative scores (at a 5% level), but they are less influential in driving Q2 scores.