EEPRU

Policy Research Unit in Economic Evaluation of Health and Social Care Interventions

Research Report

Title

Case-Mix Methodology for the NHS Outcomes Framework GP Patient Survey Questionnaire Data

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EXECUTIVE SUMMARY

Objective

The objective of the research described in the current report was to explore alternative methodologies which could be used to determine whether the health status of people living with long-term conditions in England is changing over time, all other factors being equal.

Method

Data from the Health Survey for England (HSE) were used in the analyses and EQ-5D was used to represent health related quality of life (HRQoL). The proposed case-mix ratio approach which utilised ordinary least square regressions (with the EQ-5D preference-based score as the dependent variable) was replicated, and alternatives using logistic regressions and two-part models (both using the responses to the EQ-5D health dimensions as the dependent variables) were explored. An alternative method using the HSE year as a performance indicator (PI) was explored and results presented for the four most prevalent health conditions. Results were compared in terms of errors in predicted scores and the ability to capture changes in the distributions of the preference-based scores. Both expected and simulated values were compared.

Results

The EQ-5D data were not normally distributed irrespective of survey or health condition. The annual fluctuations in mean EQ-5D scores, and the proportions in full health, were relatively small overall but differed substantially by health condition. The annual fluctuations in mean EQ-5D scores did not necessarily describe the shifts in the EQ-5D distributions.

Comparing the predicted results from the ordinary least squares (OLS) regressions and the health dimensions models, magnitude and statistical significance of the coefficients in the models differed by health condition. While the linear model was more accurate in terms of errors in the mean of predicted values for the base year (2003), it was less accurate than the logistic models for two of the remaining four surveys. The approaches were not particularly accurate at predicting EQ-5D scores across the full range of the EQ-5D index. However, the dimension models replicated the observed distributions well, unlike the linear models which produced a normally distributed sample with a proportion of scores outside the bounds of the index. The substantial errors in the predicted scores had implications with regard to the face validity of using a case-mix adjustment factor, which was based on a ratio of individual observed and predicted scores.

The results for the performance indicator models were promising and again the logistic dimension models out-performed the linear models. The magnitude and statistical significance of the coefficients in the models were both condition and health dimension specific. The linear models again predicted mean EQ-5D scores more accurately than the dimension models, but the latter performed better across the range of the EQ-5D index in terms of mean errors and mean absolute errors. This was reflected in distributions of predicted scores as the linear models predicted scores outside the EQ-5D range, covered a truncated range and did not capture the characteristics of the actual data.

Conclusion

While linear models obtained using OLS regressions performed well on the aggregate level, they did not capture the underlying distributions of the EQ-5D scores and were not able to detect shifts in these. The bias in the errors of predicted values raised questions relating to confidence in any case-mix adjustment derived from a ratio based in individual predicted scores. The results from the logistic models appeared to capture the underlying distributions far better than the linear models but additional research is required to develop this approach further.

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1. INTRODUCTION

1.1 Background

The Department of Health (DH) is in the process of rolling out a long term cross-sectional biannual postal survey due to commence in July 2011. The survey forms part of the NHS Outcomes Framework and seeks to capture how successfully the NHS is supporting people with long-term conditions to live as normal a life as possible. The survey involves a questionnaire entitled The GP Patient Survey (GPPS) and the data collected using the questionnaire will be used to determine whether the self-reported health status of people living with limiting long-term conditions is changing over time, all other factors being equal. Health status will be quantified using the three level EQ-5D generic health related quality of life (HRQoL) instrument and the associated preference-based utility measures which will be generated using the UK algorithm.[Dolan 1996]

Changes in HRQoL is one of several indicators in the Outcomes Framework which will be used to: hold the NHS Commissioning Board to account for the outcomes demonstrated, provide a national level overview of how well the NHS is performing, and act as a catalyst for driving quality improvement. Specifically, the NHS Commissioning Board will be responsible for ensuring that this particular indicator improves (or does not deteriorate) over time. While the indicator will be used at the national level, where feasible, and depending on sample sizes and information collected, the indicator will also be analysed geographically (region, Primary Care Trust, Local Authority provider) using equality strands (age, ethnicity, religion or belief, gender, disability, sexual orientation) and inequalities (socio-economic groups, deprivation identified via postcode or area). Respondents will be linked to postcodes and providers using the unique identifier number on the questionnaire.

The sample for each GPPS will be randomly selected from adults (aged over 18 years) on GPs' registered lists who have been at the practice for more than six months and who have not been surveyed in the previous twelve months. The annual sample size for the survey will be in the region of one million and the expected response rate is around 37%. The prevalence for long term health conditions is expected to be around 60% in responders.

1.2 Case-Mix

A proposed methodology for analysing case-mix adjusted changes in HRQoL over time was described in a DH report entitled The Health Status of People Living with a Long-term Condition.[Lees] The proposed approach was informed by the results of a preparatory analysis on data collected during several rounds of the Health Survey for England. The EQ-5D questionnaire was used to describe HRQoL in the analyses, and the proposed case-mix adjustment applied a correction factor for future EQ-5D scores using a ratio constructed from the differences between observed and predicted individual baseline EQ-5D scores, where the predicted values were obtained using the results of an ordinary least square regression (OLS) regression.

1.3 Objective

The objective of the research described in the current report was to explore alternative methodologies which could be used to determine if the health status of people living with long-term conditions in England is changing over time, all other factors being equal.

1.4 Constraints

As governed by the constraints of the protocol for this research, the proposed methodology was simple and transparent and can be conducted in real time using normal statistical packages. Consequently the methods explored were restricted to those which can be performed in STATA using standard commands and freely available do-files.

1.5 Data

1.5.1 Health Survey for England

Data collected during the 2003, 2004, 2005, 2006 and 2008 rounds of the Health Survey for England (HSE) were used in the analyses. These data were collected from random samples of residents in private households in England. The final dataset used in the analyses included respondents (n=13,450) who indicated they had a least one limiting long term illness (LLTI) and completed the EQ-5D questionnaire. In the HSE questionnaire, LLTIs were identified using fifteen broad categories (see Appendix A).

1.5.2 EQ-5D

The EQ-5D questionnaire, used to describe the HRQoL of respondents, consisted of five questions relating to different dimensions of health: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. There were three possible responses to each: no problem, some problem, or extreme problem. The responses were used together with preference weights obtained from a sample of the population in England to generate the EQ-5D index (range -0.594 to 1).

1.6 Overview of report structure

The following section of the report provides a description of the methodologies used. This is followed by a section where the analyses presented by Lees are replicated and compared with results obtained using different techniques. Two simple alternative ratio case-mix adjustments are then compared with the proposed adjustment factor. The penultimate section describes an approach using a performance indicator which could be used as an alternative to the proposed case-mix adjustment ratio. The final section includes a discussion of the results of the analyses, together with suggestions where the proposed methodologies could be developed and expanded.

2. METHODS

The OLS regressions reported by Lees were replicated using the data from the 2003 HSE. Alternatives were explored including response-mapping and two-part models. The analyses were then replicated using the full set of pooled data (pooling from Surveys 2003, 2004, 2005, 2006 and 2008) in the regressions, with the Survey years used as an explanatory variable. Finally, individual statistical models were obtained for individuals with specific health conditions, as opposed to using the full dataset irrespective of health status. To enable direct comparison with Lees' results, explanatory variables were retained in all models generated irrespective of statistical significance.

2.1 Statistical models

2.1.1 OLS regressions

Following the methods described in Lees' report, data from respondents (n=3,397) who indicated they had a LLTI during the 2003 HSE were used to derive a linear model using an OLS regression. The model is referred to as the "Linear" model from here on and is of the form:

$$\text{EQ-5D} = \alpha + \beta_1 x + \beta_2 x + \ldots\ldots + \beta_n x + \varepsilon$$

The EQ-5D preference index was the dependent variable and explanatory variables included: age, 15 different long-term conditions, sickness, smoking status, deprivation and an indicator of mental health problems (General Health Questionnaire (GHQ)).

2.1.2 Ordered logit models

Models obtained using OLS regressions rarely perform well at the extremes of the EQ-5D index and results generated using 'response mapping' may provide an alternative. In response mapping, the responses to the health dimension questions are used as the dependent variable (as opposed to the EQ-5D preference-based index) in categorical regressions. Using the same dataset as in the OLS regressions, five ordered logit models (one for each of the health dimensions) were obtained. For each dimension d_i (i=mobility, self-care, usual activities pain/discomfort, anxiety/depression), the probability (P) that this value is either 1, 2 or 3 is calculated:

$$p(d_i = 1) = \frac{\exp\left(\beta_1^i x_1 + \beta_2^i x_2 + ...\beta_n^i x_n - k_1^i\right)}{1 - \exp\left(\beta_1^i x_1 + \beta_2^i x_2 + ...\beta_n^i x_n - k_1^i\right)}$$

$$p(d_i = 2) = \frac{\exp\left(\beta_1^i x_1 + \beta_2^i x_2 + ...\beta_n^i x_n - k_2^i\right)}{1 - \exp\left(\beta_1^i x_1 + \beta_2^i x_2 + ...\beta_n^i x_n - k_2^i\right)} - p(d_i = 1)$$

$$p(d_i = 3) = 1 - p(d_i = 1) - p(d_i = 2)$$

Within this, the β's reflect the weight given to the various background variables and k's define the separation between the probabilities. The results of these regressions are referred to as the "Dimension" models from here on.

2.1.3 Two-part models

As datasets of EQ-5D scores typically exhibit a mass at full health (EQ-5D score = 1), it is possible that a two-part model may be appropriate. This was explored by first using a probit model to predict the probability of scoring full health (i.e. EQ-5D = 1):

$$\Pr(Y = 1|X) = \Phi(X'\beta)$$

As in the previous models, explanatory variables included: age, 15 different long-term conditions, sickness, smoking status, deprivation and an indicator of mental health problems (GHQ). Data from respondents who did not score full health were then used to obtain five ordered logit models for the responses to the five health dimensions. The results of these analyses are referred to as the "2 part" models from here on.

2.1.4 Predicting EQ-5D preference-based scores

While it is straightforward to obtain predicted EQ-5D scores from the linear models (simply using the beta's), it is not as simple for the logistic models as these predicted a range of probabilities on the health dimensions as opposed to a point estimate for the EQ-5D. One method which could be used to calculate a point estimate would be to calculate an expectation using the weighted average obtained by using the probabilities of scoring no, some or extreme responses on the dimensions. I.e. the EQ-5D scores for each of the 243 possible health states are be weighted using the probabilities of being in these health states with the latter being the predicted values obtained from the ordered logit regressions. As this method produces the average expected EQ-5D preference-based score for each individual, as opposed to an actual EQ-5D score, it is not expected that the predicted values will replicate the distribution of the actual EQ-5D scores. For example using the expected scores, it is not possible to generate a score of one and the gaps in the distribution which are observed in actual EQ-5D datasets will not be apparent.

An alternative method would be to predict the distribution of outcomes by summing up (over all individuals) the probabilities for all 243 states and taking an average over each outcome. An alternative, leading to a similar result would be to use Monte-Carlo simulations (1,000 samples) to explore the ability of the models to capture the uncertainty in the beta coefficients and the distributions of the actual EQ-5D scores for both the linear models and the dimension models. As this method generates an actual EQ-5D preference-based score, it is expected that the distribution of the predicted scores for the health dimension models would exhibit the same characteristics as the distribution of the actual EQ-5D scores. For example, the distribution of predicted EQ-5D scores should have a mass at one, followed by two distinct distributions centred around the values of approximately 0.8 and 0.2 (depending on the actual data). These analyses would be useful to examine the underlying distribution and potentials shifts in data across survey years.

2.2 Case-mix

2.2.1 Case-mix ratio adjuster

The case-mix adjustment proposed by Lees utilises the average of the individual ratios in three stages:

$$r_{iy} = \left(\frac{E_{iy}}{\hat{E}_{iy}}\right)$$

$$\bar{r}_y = \frac{1}{n}\sum_{i=1}^{n} r_{i,y}$$

$$\tilde{E}_y = \hat{E}_{03} * \bar{r}_y$$

Whereby r = ratio, y = survey year, i = individual respondent, E = observed EQ-5D score, $\hat{E}$ = predicted EQ-5D score, $\tilde{E}$ = case-mix adjusted EQ-5D score.

An alternative case-mix adjustment utilises the ratio of the individuals summed:

$$\bar{r}_y = \frac{\frac{1}{n}\sum_{i=1}^{n} E_{iy}}{\frac{1}{n}\sum_{i=1}^{n} \hat{E}_{iy}}$$

$$\tilde{E}_y = \hat{E}_{03} * \bar{r}_y$$

In both alternatives:

If $\bar{r}_y > 1$ there is a 'technology' improvement in year *y* compared to the base year

If $\bar{r}_y < 1$ there is a 'technology' decrease in year *y* compared to the base year

If $\bar{r}_y = 1$ 'technology' in year *y* is the same as the base year (here base year is 2003)

2.2.2 Performance indicator

One alternative to using a case-mix adjustment would be to include an explanatory variable as a performance indicator (PI) within the regressions. The possibility of using an explanatory variable to represent the survey year was explored using pooled data with data from the 2003 survey as the base year. A linear model (PI linear model) was obtained using an OLS regression, and five ordered logit models for the health dimensions (PI dimension model).

2.3 Condition specific models

In addition to including the survey year as performance indicator, in the PI dimension models, the other health dimensions were included as continuous explanatory variables. Informed by the results of exploratory analyses, and an *a priori* belief that the relationships between the explanatory variables and the health dimensions could be condition specific, the PI models were generated for the four most prevalent health conditions: musculoskeletal conditions (n=7,716), stroke (n=4,154), chronic obstructive pulmonary disease (COPD) (n= 2,531), and diabetes (n=2,148) as opposed to all respondents with LLTIs.

2.4 Comparison of statistical models

The goodness of fit of the models was assessed using standard summary statistics (mean, standard deviation (sd), range) and the ability of the statistical models to predict mean EQ-5D scores was assessed using the mean absolute error (MAE) in the individual level predictions. Models obtained using OLS regressions on EQ-5D data tended to under-predict and over-predict values at the top and bottom of the index respectively. Systematic bias in the predicted scores was assessed by calculating the mean error (ME), and the MAE in the individual level predictions for sub-groups of respondents categorised by actual EQ-5D score (EQ-5D < 0; 0 ≤ EQ-5D < 0.5; 0.5 ≤ EQ-5D < 0.75; EQ-5D ≥ 0.75). The ability of the models to describe and explain the underlying distributions of the EQ-5D data was assessed graphically using 1,000 Monte-Carlo simulations. The ability of the models to identify potential shifts in distributions over time was examined using box-plots and histograms.

3. RESULTS (Summary statistics and EQ-5D data)

3.1 Limiting Long-Term Illness

A total of 13,540 respondents indicated they had at least one LLTI across the five surveys. Almost 60% (7,716/13,540) of these reported they had a musculoskeletal condition with the percentage in each year varying between 49% (472/966) in 2004 and 61% (1,595/2,623) in 2005. The prevalence of some of the conditions was relatively small and only 1% and 2% of respondents indicated they had an infectious disease or blood disorder respectively (see Appendix).

3.2 Summary Statistics for EQ-5D

3.2.1 Summary of changes in EQ-5D index for all respondents with LLTI

The EQ-5D scores covered the full range (-0.594 to 1) with minimum scores of -0.349 and -0.429 for the 2003 and 2005 surveys respectively. The proportion of respondents in full health (EQ-5D = 1) varied slightly (from 14.7% in 2008 to 16.3% in 2003). The fluctuation in mean annual EQ-5D scores for all respondents with LLTI was relatively small (Table 1), ranging from 0.6071 in 2004 to 0.6484 in 2003.

Table 1: Changes over time in EQ-5D scores for all respondents with LLTIs

	2003	2004	2005	2006	2008
n	3,397	955	2,623	3,167	3,398
EQ-5D, mean	**0.6484**	0.6071	0.6395	0.6324	0.6210
EQ-5D, sd	0.2977	0.3332	0.2984	0.3116	0.3144
EQ-5D, min	-0.349	-0.594	-0.429	-0.594	-0.594
EQ-5D, max	1	1	1	1	1
EQ-5D=1, %	**16.3**	15.9	15.3	16.0	14.7

Across surveys: bold = largest; underscore = smallest.

3.2.2 Summary of changes in EQ-5D index for the four most prevalent health conditions

Looking at the four most prevalent LLTIs, there was a relatively large variation in mean EQ-5D scores within the same survey (Table 2). For example, in the 2003 survey the mean EQ-5D scores ranged from 0.5855 (musculoskeletal conditions) to 0.6693 (COPD). The fluctuation in mean EQ-5D scores for the specific condition sub-groups differed across the surveys. For example, the highest mean EQ-5D scores in the 2005 survey were observed in sub-groups with diabetes or musculoskeletal conditions while the highest in the 2003 survey was observed in sub-groups with either stroke or COPD.

The changes in mean EQ-5D scores did not necessarily reflect the changes in the proportions of respondents in full health (EQ-5D = 1). For example, for the sub-groups with diabetes, while the largest annual mean EQ-5D score was observed in the 2005 survey, this survey had the lowest proportion (9.9%) of respondents in full health (range for other years: 11.2% to 15.0%). The converse was observed in the sub-group with musculoskeletal conditions where the lowest annual mean EQ-5D (0.5255) score for this group was observed in conjunction with the highest proportion (9%) of respondents in full health in the 2004 survey.

Table 2: Changes over time in EQ-5D scores for respondents with prevalent LLTIs

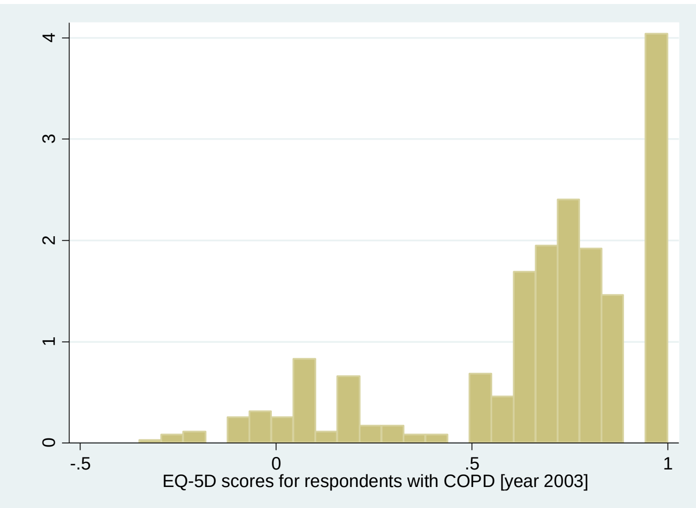
	2003	2004	2005	2006	2008
Diabetes (n=2,148)					
n	410	182	439	505	612
EQ-5D, mean	0.5955	<u>0.5311</u>	**0.6206**	0.5930	0.5722
EQ-5D = 1, %	**12.4**	11.2	<u>9.9</u>	15.0	12.1
Stroke (n=4,154)					
n	949	266	953	948	1,038
EQ-5D, mean	**0.6126**	<u>0.5495</u>	0.6053	0.5853	0.5905
EQ-5D = 1, %	11.8	11.7	11.7	**12.5**	<u>11.4</u>
COPD (n=2,531)					
n	621	187	495	584	644
EQ-5D, mean	**0.6693**	<u>0.5901</u>	0.6303	0.6319	0.6171
EQ-5D = 1, %	**22.7**	19.8	19.0	20.6	<u>18.8</u>
Musculoskeletal (n=7,716)					
n	1,960	472	1,595	1,797	1,892
EQ-5D, mean	0.5855	<u>0.5255</u>	**0.5884**	0.5690	0.5525
EQ-5D = 1, %	<u>8.4</u>	**9.0**	8.9	8.5	8.6

Across surveys: bold = greatest; underscore = lowest

3.3 Distribution of EQ-5D scores

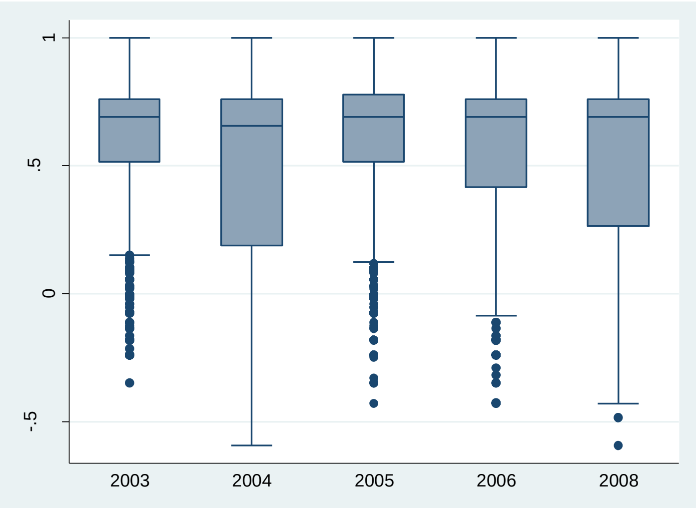
The EQ-5D scores were not normally distributed irrespective of survey year or health condition. The distributions for all the sub-groups had a long negative skew, a mass at full health, a second group centred around approximately 0.75 and a third group centred around approximately 0.1. Figure 1 provides an example using the sub-group with COPD (2003 survey). Additional examples are provided in the later sections.

Figure 1: Exemplar of distribution of EQ-5D scores



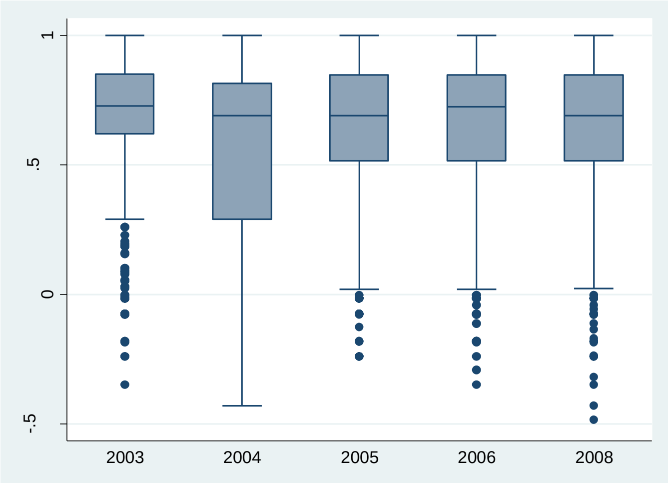
The sub-groups with musculoskeletal conditions had the smallest change in mean EQ-5D scores over the different surveys (ranging from 0.5255 in 2003 to 0.5884 in 2005, Table 2). However, there were substantial shifts in the distributions. For example, 25% of respondents scored below 0.1875 in 2004 whereas the 25% percentile in the 2003 and 2005 surveys was 0.516 (Figure 2). Although the sample was relatively small for the 2003 survey (n=472) the sample size for the 2005 survey (n=1,892) was comparable with the other years (range: 1,595 to 1,960).

Figure 2: Changes in EQ-5D scores for respondents with musculoskeletal conditions



Looking at respondents with COPD, while there was a relatively large variation in mean EQ-5D scores for the sub-groups with COPD over time (range: 0.5901 in 2004 to 0.6693 in 2003), the median values were relatively stable (Figure 3). When comparing the surveys 2005 (mean EQ-5D = 0.6303) and 2008 (mean EQ-5D = 0.6171), the distributions remained fairly constant with the central 50% of respondents scoring between 0.516 and 0.848 in both surveys (Figure 3).

Figure 3: Changes in EQ-5D scores for respondents with COPD



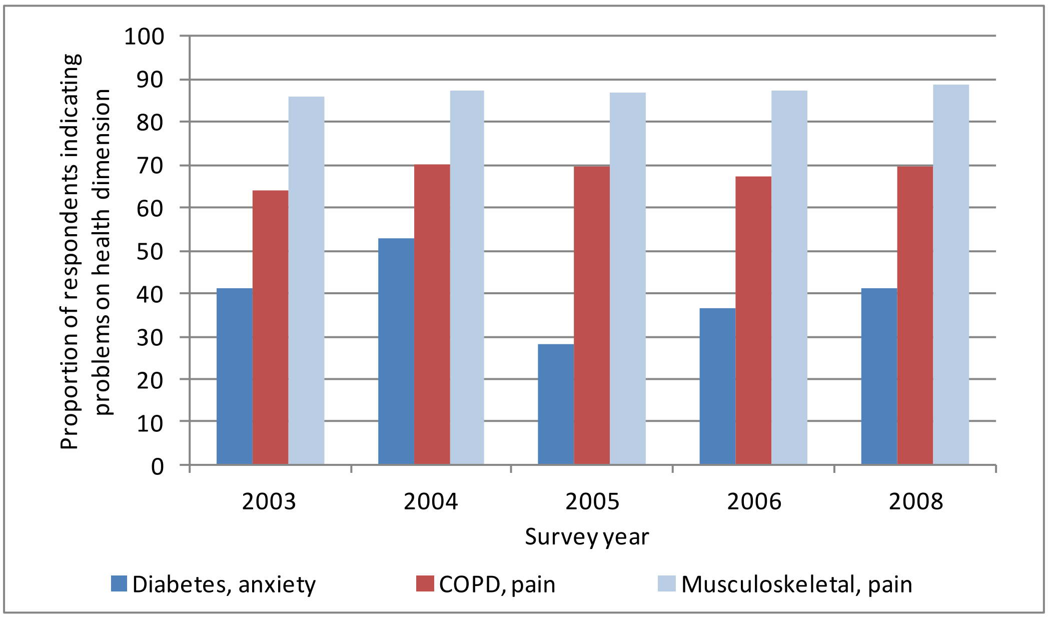
3.4 Health dimensions

3.4.1 Proportions of respondents with problems in each of the health dimensions

The proportions of all respondents with LLTI who indicated they had problems on the five health dimensions remained stable across the surveys for some of the dimensions but varied substantially for others (Table A3). For example, the proportions who indicated problems with pain/discomfort ranged from 71% in 2003 to 74% in 2005. Conversely, the proportions indicating problems with anxiety/depression ranged from 30% in 2005 to 49% in 2004. The large fluctuations across the surveys for the proportions of respondents who indicated they had problems with anxiety were observed in the prevalent LLTIs (Table A4). For example, for the sub-groups with diabetes, the proportions ranged from 28% in 2005 to 53% in 2004 (Figure 4).

There were substantial differences in the proportions of respondents who indicated they had problems in each of the dimensions when comparing across sub-groups with the LLTIs reflecting the different aspects of health affected by the particular conditions (Table A4). For example, between 64% and 70% of respondents with COPD had problems with pain/discomfort compared to between 86% and 89% of respondents with musculoskeletal conditions (Figure 4).

Figure 4: Changes in proportions of respondents with problems on health dimensions



Data shown are: problems in anxiety/depression for the sub-groups with diabetes, problems in pain/discomfort for the sub-groups with either COPD or musculoskeletal conditions.

3.4.2 Equating changes in EQ-5D scores with changes in proportions in health dimensions

The sub-groups with diabetes have been used as an example to assess changes in EQ-5D preference scores and the proportions indicating no problems on the health dimensions (Table 3). The smallest mean EQ-5D was observed in the 2004 survey and the proportions indicating no problems on mobility and no problems on usual activities increased slightly compared to the base year. However, the proportion of respondents indicating no problems with anxiety/depression decreased compared to the proportion in the base year (2004 = 47% vs. 2003 = 59%), as did the proportion of respondents indicating no problems with pain/discomfort (2004 = 17% vs. 2003 = 22%). The largest mean EQ-5D was observed in the 2005 survey and the proportions of respondents indicating no problems increased in 2005 compared to the base year in the dimensions: usual activities (2005 = 45% vs. 2003 = 41%), pain/discomfort (2005 = 25% vs. 2003 = 22%), anxiety/depression (2005 = 72% vs. 2003 =59%).

Table 3: Proportion of respondents with diabetes who have problems in health dimensions

	2003	2004	2005	2006	2008
Mean EQ-5D	0.5955	0.5311	**0.6206**	0.593	0.5722
Mobility					
No problems	38	**40**	37	37	34
Some problems	62	59	63	62	66
Extreme problems	0	1	0	1	1
Self-care					
No problems	79	76	**79**	77	75
Some problems	20	20	20	21	23
Extreme problems	2	3	1	2	2
Usual activities					
No problems	41	45	**45**	41	39
Some problems	50	47	46	50	51
Extreme problems	9	9	10	10	9
Pain/discomfort					
No problems	22	17	**25**	21	21
Some problems	61	59	58	64	61
Extreme problems	17	24	17	15	18
Anxiety/depression					
No problems	59	47	**72**	63	59
Some problems	36	45	25	31	35
Extreme problems	5	8	3	6	7

Across surveys: bold = largest proportion with no problems, underscore = largest proportion with problems

3.5 Section synopsis and discussion

- The EQ-5D data were not normally distributed irrespective of survey or health condition.
- The annual fluctuations in mean EQ-5D scores and proportions in full health were relatively small when comparing all respondents with LLTIs.
- The annual fluctuations in mean EQ-5D scores and proportions in full health differed by LLTI.
- The magnitude of annual fluctuations in mean EQ-5D scores did not necessarily capture shifts in the distributions of EQ-5D scores.
- The annual fluctuations in proportions of respondents with problems on the five health dimensions differed across LLTIs.
- The changes in proportions of respondents with problems on the five health dimensions could potentially be used to inform what aspects of health have changed relative to the base year for the individual LLTIs.

As the EQ-5D scores were not normally distributed, the mean value may not be the most appropriate measure when examining changes in HRQoL over time. Perhaps more important is knowledge of any “shift” in the distribution of EQ-5D scores compared to the base year. Similarly, while the EQ-5D preference index may show an overall change in HRQoL, the changes in proportions of respondents who have problems in the specific health dimensions will provide useful information on which aspects of health care require improvement, or have improved, relative to the base year.

4. RESULTS (Regressions using the 2003 survey as the base year)

4.1 Statistical models

The results of the regressions obtained when using all respondents with LLTI in the 2003 survey are provided in Table 4. The majority of the coefficients for the individual health conditions in the linear model were statistically significant ($p<0.05$) and had a detrimental effect on the EQ-5D scores. There were exceptions whereby the coefficients suggested a particular LLTI improved HRQoL relative to the base. This is not unexpected for the eye and ear related conditions as there is evidence suggesting the EQ-5D questionnaire may not capture the aspects of HRQoL affected by these conditions.

The statistical significance and magnitude of the coefficients in the health dimension models were specific to both the LLTI and the health dimension. For example, the diabetes coefficient in the linear model was statistically significant but only the diabetes coefficients in the pain and anxiety dimension models were statistically significant. The musculoskeletal coefficient (-0.1621 $p<0.05$) in the linear model was statistically significant and was the largest of the coefficients for the LLTI variables. The musculoskeletal coefficients for the mobility (1.3078 $p<0.05$) and pain (1.8519 $p<0.05$) dimension models were also large compared to the coefficients for the other LLTIs. Conversely, the musculoskeletal coefficient (0.0534 $p=0.55$) for the anxiety dimension model was not statistically significant and was relatively small compared to the coefficients for the other LLTIs.

All the coefficients for the other explanatory variables in the linear model were statistically significant. While the majority were also statistically significant in the health dimension models, there were exceptions. For example, the coefficients for acute sickness were not statistically significant in the self-care and the anxiety dimension models. Similarly, the deprivation coefficients were not all statistically significant in the anxiety dimension model. In addition, the magnitude of the coefficients differed across the dimensions. For example, the GHQ high coefficient was 1.764 ($p<0.05$) for the anxiety dimension compared to 0.6290 ($p<0.05$) for mobility dimension model.

Table 4: Regressions results, using all respondents with LLTI in the 2003 survey

		Linear	Dimension models				
		EQ-5D	Mobility	Self-care	Usual A	Pain	Anxiety
	n	3,397	3,397	3,397	3,397	3,397	3,397
Age		-0.0031*	0.0519*	0.0321*	0.0272*	0.0198*	0.0057*
Cancer	147	-0.0807*	0.4741*	0.2515	0.4280*	0.6687*	0.6216*
Diabetes	410	-0.0416*	0.1896	0.2299	0.1602	0.3775*	0.3852*
Mental disorder	320	-0.1128*	-0.1488	0.2167	0.1325	-0.4133*	2.4226*
Epilepsy	402	-0.0977*	0.7661*	0.8175*	0.7340*	0.6272*	0.3749*
Eye	218	0.0134	0.0378	0.0449	0.0269	-0.3153*	0.0242
Ear	193	0.0319	-0.3937*	-0.2690	-0.4939*	-0.3581*	0.0977
Stroke	949	-0.0290*	0.5788*	0.3164*	0.3315*	0.1668	0.1378
COPD	621	-0.0027	0.3435*	0.0491	-0.0327	-0.0379	-0.0406
Digestive	411	-0.0463*	-0.0127	0.4180*	0.2298*	0.4748*	0.1538
Kidney	196	0.0190	-0.1537	-0.2963	-0.4023*	0.0591	-0.1718
Skin	112	0.0016	-0.1025	0.1852	0.0491	0.0623	-0.0703
Musculoskeletal	1960	-0.1621*	1.3078*	0.9003*	0.8469*	1.8519*	0.0534
Infectious Disease	19	-0.0156	0.3904	0.6829	0.4454	0.1890	-0.1090
Blood	62	-0.0341	0.3889	-0.0910	-0.1470	0.2234	0.4157
Other condition	16	-0.1767*	0.7399	-0.3824	1.1486*	1.3452*	1.5687*
A little deprived (Base)							
Least deprived	673	0.0324*	-0.2518*	-0.2630	-0.2577*	-0.2473*	-0.3140*
Very deprived	745	-0.0500*	0.2476*	0.4255*	0.2880*	0.3476*	0.0537
Most deprived	681	-0.0779*	0.4543*	0.6224*	0.3660*	0.4491*	0.1679
GHQ = medium (Base)							
GHQ- low		0.0663*	-0.4635*	-0.5367*	-0.8016*	-0.3493*	-0.9059*
GHQ- high		-0.1701*	0.6290*	0.8969*	0.7354*	0.7172*	1.7664*
Smoker		-0.0480	0.4286*	0.2021	0.1530	0.3514*	0.3718*
Sickness 0 days (base)							
Sickness < 6/14 days		-0.0523*	0.3904*	0.2702	0.4646*	0.4864*	0.2844
Sickness < 13/14 days		-0.0659*	0.3924*	0.3032	0.5777*	0.4711*	0.1557
Sickness 14/14 days		-0.1170*	0.7747*	0.7193*	1.1677*	0.6542*	0.0710
Constant		1.0329*					

* $p<0.05$

4.2 Predictive abilities of the statistical models

When comparing the ability of the three models to predict the annual mean EQ-5D scores (Table 5), the linear model performed best in terms of mean scores for the 2003 survey, as would be expected given the model was fitted using an OLS regression. The linear model also produced the most accurate results for the 2005 and 2006 surveys. However, the dimension models produced the most accurate mean EQ-5D score for the 2004 and 2008 surveys. Although the differences were small, the linear model had the smallest MAEs and MSEs across all survey years.

Table 5: Comparing the predictive abilities of the models

	2003	2004	2005	2006	2008
n	3,397	955	2,623	3,167	3,398
Actual mean EQ-5D scores					
	0.6484	0.6071	0.6395	0.6324	0.6210
Predicted mean EQ-5D scores					
Linear	**0.6484**	0.6228	**0.6282**	**0.6393**	0.6346
Dimension	0.6284	**0.6114**	0.6064	0.6193	0.**6143**
2 part	0.5646	0.5463	0.5577	0.5595	0.5566
Mean Errors					
Linear	**0.0000**	-0.0157	**0.0113**	**-0.0069**	-0.0135
Dimension	-0.0200	**0.0043**	-0.0331	-0.0131	**-0.0067**
2 part	-0.0838	-0.0607	-0.0818	-0.0729	-0.0645
Mean Absolute Errors					
Linear	**0.1830**	**0.2013**	**0.1923**	**0.1901**	**0.1955**
Dimension	0.1859	0.2015	0.1978	0.1922	0.1967
2 part	0.2247	0.2406	0.2280	0.2293	0.2305
Mean Squared Errors					
Linear	**0.0582**	**0.0694**	**0.0628**	**0.0634**	**0.0660**
Dimension	0.0587	0.0701	0.0646	0.0638	0.0663
2 part	0.0719	0.0826	0.0744	0.0764	0.0769

Bold = most accurate results and smallest errors for the survey year

4.3 Comparing the accuracy of the models across the EQ-5D index

Accuracy in predictions across the range of EQ-5D scores is particularly important if a case-mix adjustment is based on the individual patient scores. No additional results are presented for the 2-part model due to the poor performance relative to the linear and dimension models. When comparing the linear and dimension models, neither performed particularly well when examining errors in predicted values for sub-groups categorised by actual EQ-5D score (Table 6). The predictions obtained from the dimension models were more accurate in terms of MAEs at the lower end of the EQ-5D index (EQ-5D <0.5) while the converse was true at the top of the index (EQ-5D ≥0.75).

Table 6: Errors in predicted EQ-5D scores sub-grouped by actual EQ-5D scores

Survey year	2003	2004	2005	2006	2008
EQ-5D < 0					
n	185	80	160	208	230
Actual mean EQ-5D	-0.0750	-0.1143	-0.0754	-0.0984	-0.0949
Linear mean EQ-5D	0.4179	0.4222	0.4304	0.4171	0.4103
Dimension mean EQ-5D	0.3919	0.4155	0.4052	0.3955	0.3874
Linear MAE	0.4929	0.5365	0.5058	0.5155	0.5052
Dimension MAE	**0.4669**	**0.5298**	**0.4806**	**0.4939**	**0.4823**
0≤ EQ-5D < 0.5					
n	473	152	351	446	504
Actual mean EQ-5D	0.1857	0.1899	0.1858	0.1792	0.1718
Linear mean EQ-5D	0.5266	0.4989	0.5250	0.5168	0.5239
Dimension mean EQ-5D	0.5158	0.4921	0.5079	0.5020	0.5087
Linear MAE	0.3437	0.3108	0.3419	0.3408	0.3550
Dimension MAE	**0.3357**	**0.3087**	**0.3290**	**0.3315**	**0.3428**
0.5 ≤ EQ-5D < 0.75					
n	1,360	355	1,124	1,298	1,379
Actual mean EQ-5D	0.6680	0.6589	0.6666	0.6663	0.6618
Linear mean EQ-5D	0.6167	0.5852	0.5991	0.6123	0.6057
Dimension mean EQ-5D	0.6016	0.5820	0.5795	0.5974	0.5895
Linear MAE	**0.1161**	0.1243	**0.1217**	0.1182	**0.1236**
Dimension MAE	0.1166	**0.1209**	0.1280	**0.1175**	0.1252
EQ-5D ≥ 0.75					
n	1,379	368	988	1,215	1,285
Actual mean EQ-5D	0.8849	0.8862	0.8855	0.8876	0.8816
Linear mean EQ-5D	0.7525	0.7539	0.7299	0.7510	0.7491
Dimension mean EQ-5D	0.7253	0.7317	0.7045	0.7241	0.7230
Linear MAE	**0.1524**	**0.1575**	**0.1687**	**0.1560**	**0.1546**
Dimension MAE	0.1651	0.1635	0.1850	0.1692	0.1649

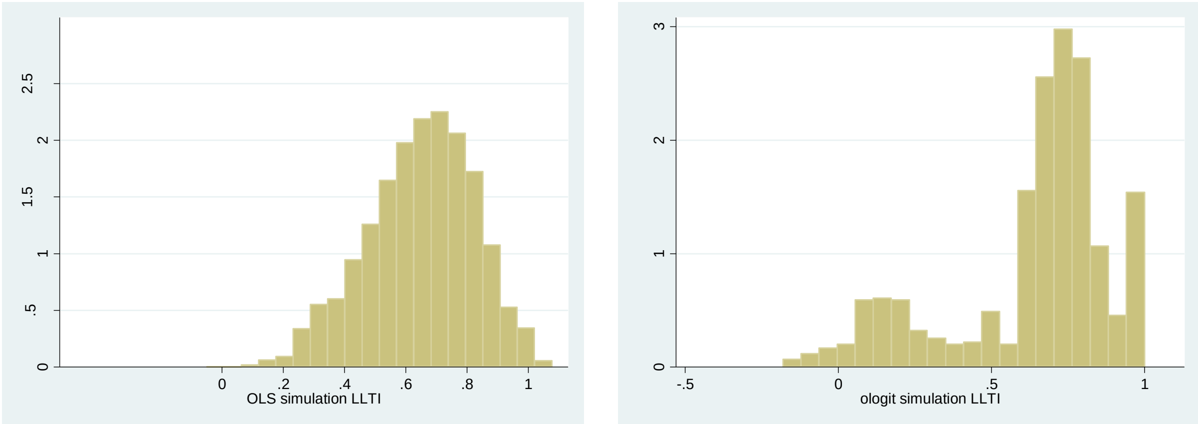
Bold = smallest errors

4.4 Monte-Carlo simulations

The expected values compared above, do not take into account the uncertainty in the beta coefficients or the distribution of the underlying data. Using Monte-Carlo simulations (Figure 5), the dimension models captured the characteristics of the observed EQ-5D data well. However, the predictions obtained from the linear model were more normally distributed, had a truncated range at the bottom of the index and predicted scores outside the limits of the EQ-5D index (i.e. EQ-5D >1).

Figure 5: Distributions of simulated EQ-5D scores

Linear model simulation *Dimension model simulation*



4.5 Section synopsis and discussion

- The magnitude and statistical significance of the coefficients in the models differed by: health condition and dependent variable.
- The linear model was more accurate than the dimension models in terms of predicting mean EQ-5D scores for the base year, but less accurate than the dimension models for two of the other four surveys.
- The approaches were not particularly accurate at predicting EQ-5D scores across the full range of the EQ-5D index.
- The simulations generated using the dimension models replicated the distribution of the actual EQ-5D scores.
- The simulations generated using the linear model produced a normally distributed sample with a small proportion of predicted scores outside the bounds of the index.

If the objective is just to examine changes in mean EQ-5D scores across surveys, a linear model obtained using OLS regressions could be viewed as one possible approach. However, out-of-sample predictions will only be accurately predicted within a truncated range of the EQ-5D index. If there are shifts in the underlying distribution of EQ-5D scores across the surveys, this approach may produce inaccurate predictions with substantial errors. This has implications with regard to confidence in a case-mix adjustment which is formed on the basis of ratios of individual level predictions.

The errors in the expected predictions were not normally distributed which violates a basic assumption for OLS regressions and undermines confidence in the statistical significance of the beta coefficients. Due to the time constraints for the project, standard statistical tests were not performed on any of the models generated.

5. RESULTS (Case-mix adjustment)

A number of alternatives to the case-mix adjustment proposed by Lees were considered and these are presented below. The ratio for each year is presented (for 2003 the ratio = 1 as this is the base-case, for subsequent years ratios > 1 indicate 'technology improvement'). If modelled ratios for 2003 were not equal to unity, all results were scaled so that they did.

5.1 Alternative ratio

'The average of the individual ratios' proposed by Lees was replaced with 'the ratio of individuals summed'.

This was done using three approaches:

A. Lees' original (OLS) approach.

B. Modelling the underlying domains (ordered logit) to derive probabilities of being in each of the 243 health domains, from which a specific health state was chosen (with the probability of being chosen equal to the calculated probabilities). To stabilise results, the average of 1,000 simulations was used.

C. Using ordered logit models as above, but using the expected value (per year) as opposed to the average of the simulated scores.

While the new adjustment factors followed the original adjustment factors in terms of identifying an "improvement" or "deterioration" relative to the base year, there were some substantial differences (Table 7). For example, when comparing the original adjustment factors with those obtained using Linear (A), the values obtained from the 2006 and 2008 surveys were comparable using the two methods, while those obtained from the 2004 and 2005 surveys differed.

Table 7: Comparing the new ratio adjustment factor with the original ratio adjustment

Year	Original adjustment factor	New adjustment factor		
		Linear (A)	Dimension (B)	Dimension (C)
2003	1	1	1	1
2004	0.957	0.975	0.959	0.962
2005	1.033	1.018	1.016	1.025
2006	0.988	0.989	0.987	0.990
2008	0.977	0.979	0.988	0.980

5.2 Regression

A regression line was fit to the observed and expected EQ-5D scores. The regression line was forced to pass through the origin and the slope was taken to be the adjustment factor. The same three approaches detailed above were used, except for (C), where the expected value was calculated per patient, not per year.

Again, in the majority of cases, the different approaches produced the same results in terms of "improvement" or "deterioration" relative to the base year, but again there were differences in the magnitude of change (Table 8). The most noticeable difference in the results across all the alternatives was the factor obtained from the 2005 survey. It is not clear which of the approaches gives the "correct" adjustment factor.

Table 8: Comparing the new regression adjustment factor with the original ratio adjustment

Year	Original adjustment factor	New adjustment factor		
		Linear (A)	Dimension (B)	Dimension (C)
2003	1	1	1	1
2004	0.957	0.987	0.958	0.974
2005	1.033	1.014	0.999	1.014
2006	0.988	0.993	0.977	0.993
2008	0.977	0.981	0.972	0.980

6. RESULTS (Regressions using Performance Indicator)

6.1 Statistical models with survey year as a performance indicator

Individual models were obtained for the four most prevalent LLTIs (diabetes, COPD, musculoskeletal, stroke) using the full sub-groups with Survey as an explanatory variable. The condition specific PI linear models mirrored the results of the linear model reported earlier (generated using just the 2003 data), in terms of the statistical significance of the coefficients (Table 9). Exceptions included the coefficients for least deprived (p=0.32) and sickness <6/14 days (p=0.88) for the diabetes model. With the exception of the year 2008 for the musculoskeletal linear model, none of the coefficients for the survey years were statistically significant.

The condition specific PI dimension models (Appendix Tables A6-A10) demonstrated that the magnitude and statistical significance of the coefficients were condition and health dimension specific. For example, the coefficients for age ranged from 0.0472 ($p<0.05$) for the mobility PI dimension model in the sub-group with COPD, to -0.0022 (p=0.60) for the pain PI dimension model in the sub-group with diabetes.

When comparing the coefficients in the PI dimension models with those in the PI 2 part model (Appendix Tables A12-A16), and looking at the same health dimension and condition, the coefficients in the 1 part model varied substantially from their counterpart in the 2 part model. For example, for the mobility PI dimension models for COPD, the coefficient for GHQ low was 0.1182 (p=0.43) compared to -0.0045 (p=0.98) for the PI 2 part model.

Several of the coefficients for the survey years were statistically significant in the PI dimension models.

Table 9: Coefficients of the PI linear models

Dependent variable: EQ-5D				
	Musculoskeletal	Stroke	COPD	Diabetes
Age	-0.0033*	-0.0018*	-0.0039*	-0.0032*
A little deprived (Base)				
Least deprived	0.0311*	0.0207*	0.0385*	*0.0177*
Very deprived	-0.0373*	-0.0307*	-0.0373*	-0.0362*
Most deprived	-0.0722*	-0.0815*	-0.0711*	-0.0858*
GHQ = medium (Base)				
GHQ- low	0.1087*	0.1248*	0.0968*	0.1276*
GHQ- high	-0.1997*	-0.1788*	-0.2320*	-0.1851*
Smoker	-0.0504*	-0.0469*	-0.0641*	-0.0560*
Sickness 0 days (base)				
Sickness < 6/14 days	-0.0538*	-0.0468*	-0.0550*	*-0.004*
Sickness < 13/14 days	-0.0958*	-0.0921*	-0.0842*	-0.0902*
Sickness 14/14 days	-0.1486*	-0.1270*	-0.1508*	-0.1668*
Year 2003 (Base)				
2004	-0.0097	0.0016	-0.0235	-0.0156
2005	0.0122	-0.0028	-0.0234	0.0138
2006	-0.0095	-0.0165	-0.0208	0.0037
2008	-0.0188*	-0.0089	-0.0257	-0.0114
Constant	0.8484*	0.7898*	0.9875	0.8709*

* $p<0.05$

6.2 Predictive abilities of the performance indicator models

When comparing the ability of the PI models to predict the annual mean EQ-5D scores (Table 10 gives the results for the COPD model), the PI linear model was the most accurate across all the survey years for each of the health conditions (additional results in Tables A17-A19, Appendix). However the MAEs and the MSEs for the PI dimension models were the smallest across all the survey years and health conditions. Perhaps surprisingly, the 2 part models did not improve the predictive abilities over the 1 part dimension models.

Table 10: Comparing the predictive abilities of the performance indicator models for COPD

Condition: COPD	2003	2004	2005	2006	2008
n	621	187	495	584	644
Actual mean EQ-5D	0.6693	0.5901	0.6303	0.6319	0.6171
Predicted mean EQ-5D					
PI linear	**0.6693**	**0.5901**	**0.6303**	**0.6319**	**0.6171**
PI dimension	0.6425	0.5696	0.6133	0.6147	0.5971
2 part	0.6431	0.5792	0.6018	0.6120	0.5923
Mean Errors					
PI linear	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
PI dimension	0.0268	0.0205	0.0170	0.0173	0.0200
2 part	0.0262	0.0108	0.0285	0.0199	0.0248
Mean Absolute Errors					
PI linear	0.1933	0.2289	0.1995	0.2083	0.2101
PI dimension	**0.1265**	**0.1480**	**0.1290**	**0.1401**	**0.1368**
2 part	0.2116	0.2483	0.2144	0.2247	0.2233
Mean Squared Errors					
PI linear	0.0652	0.0812	0.0664	0.0720	0.0733
PI dimension	**0.0262**	**0.0317**	**0.0272**	**0.0317**	**0.0297**
2 part	0.0723	0.0937	0.0720	0.0780	0.0789

Bold = most accurate results and smallest errors for the survey year

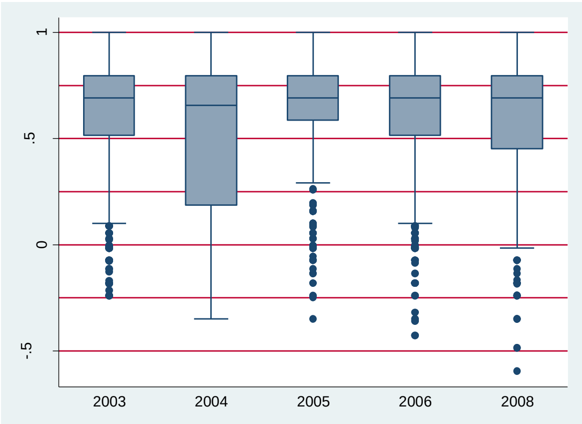
6.3 Ability of PI models to identify shifts in EQ-5D scores over time

6.3.1 Expected vales

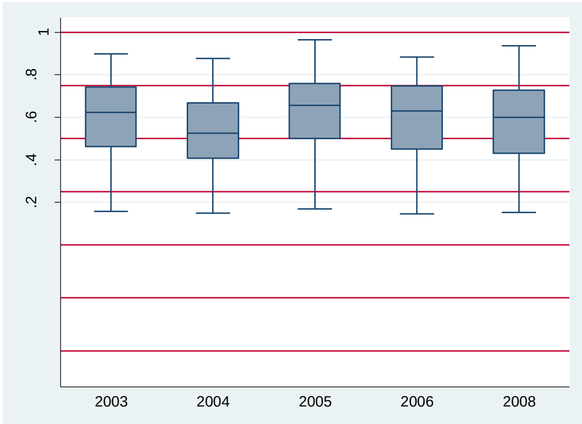
Using the diabetes results as an example, the predicted expected values covered a very truncated range of the EQ-5D index (Figure 6 with additional examples Figures A1-A3, Appendix) and the only approach which predicted values below zero was the PI dimension model. The PI dimension model was also the only method which identified that the central 50% of cases in the 2004 survey was substantially different from the other surveys. The equivalent charts for the other three prevalent LLTIs are provided in the appendix. The distributions of the actual and predicted expected EQ-5D scores for the sub-groups with diabetes for the survey years 2003 and 2004 are provided in the Appendix (Figure A4).

Figure 6: Actual and predicted PI expected EQ-5D scores

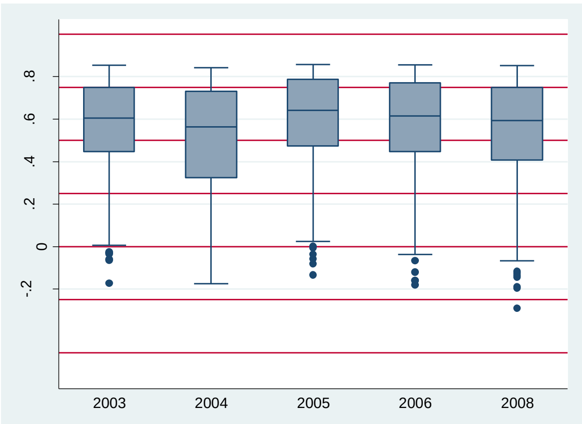
Actual EQ-5D scores Diabetes



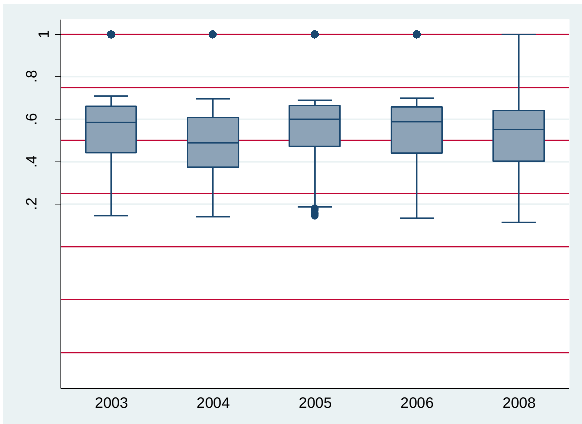
PI Linear model expected EQ-5D scores Diabetes



PI Dimension model expected EQ-5D scores Diabetes



PI 2 part model expected EQ-5D scores Diabetes

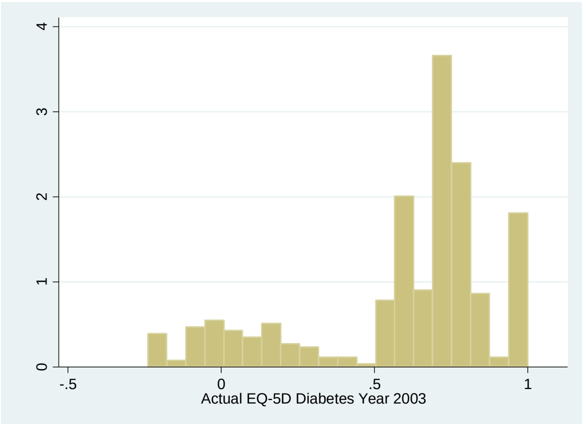


6.3.2 Comparing results using random Monte-Carlo simulations

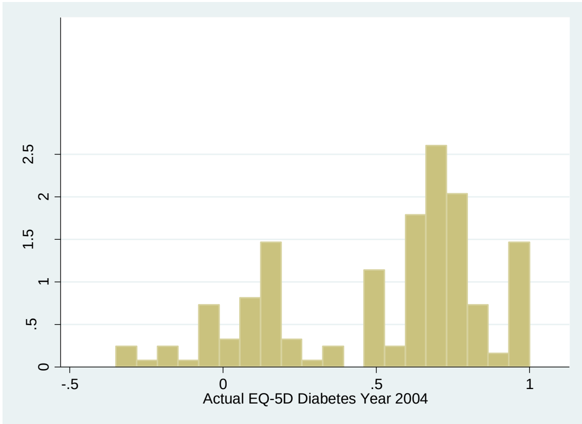
Again using the diabetes data as an example, and comparing the data for the 2003 and 2004 surveys, the shift at the top and the bottom of the actual EQ-5D index is clearly visible in the histograms (Figure 7). When comparing the samples generated using Monte-Carlo simulations (Figure 7) for the PI Linear models, it is clear there was a difference in the distributions, but as the model only predicted a truncated range it was not able to accurately reflect the correct shift in the distribution for the 2004 survey. Conversely, the distributions sampled using the PI dimension model were close approximations of the two actual distributions (Table 7).

Figure 7: Distributions of actual and predicted EQ-5D scores for Diabetes

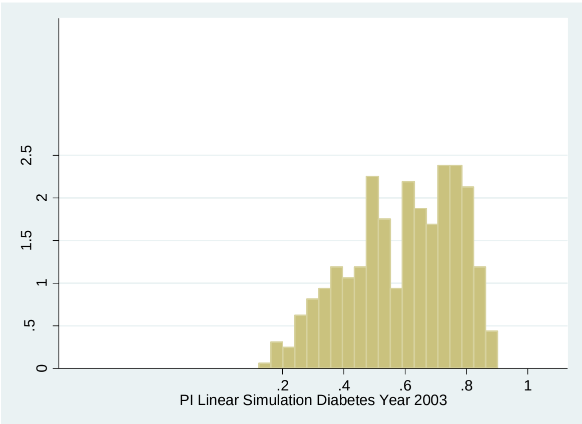
Actual Year 2003



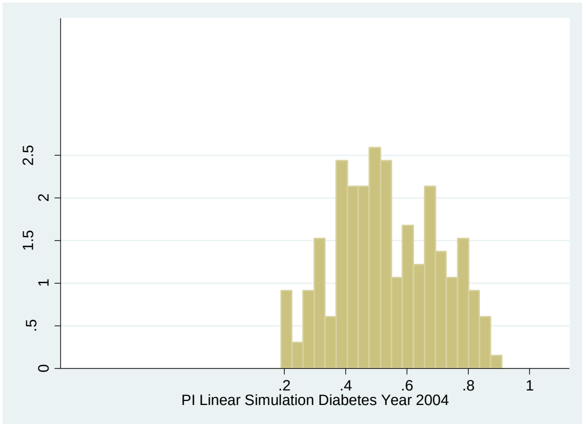
Actual Year 2004



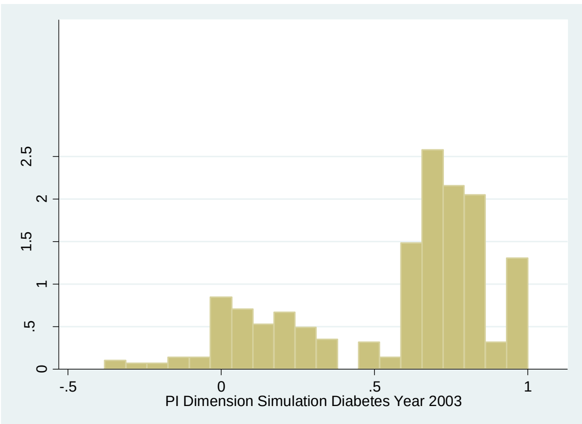
PI Linear Simulation Year 2003



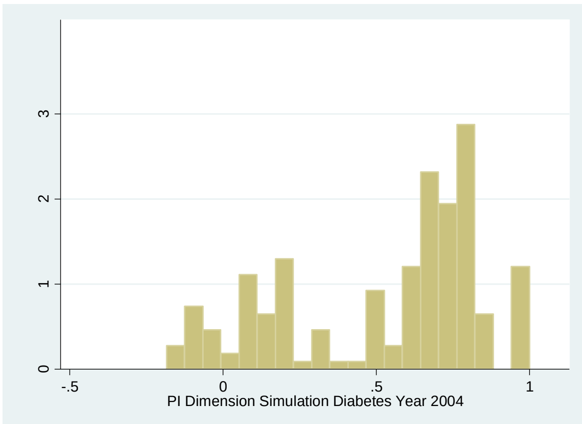
PI Linear Simulation Year 2004



PI Dimension Simulation Year 2003



PI Dimension Simulation Year 2004



6.4 Comparing the accuracy of the PI models across the EQ-5D index

When comparing the accuracy of the models across the full range of the EQ-5D index, with the exception of the category: 0.5 ≤ EQ-5D < 0.75, the PI dimension models produced the most accurate predictions across the full range of the EQ-5D index in terms of the mean errors (Table 11). The PI dimension models produced the smallest MAEs irrespective of EQ-5D category or health condition (Table 11, Tables A20-A22).

Table 11: Errors across the distribution for the diabetes PI dimension models

Diabetes	2003	2004	2005	2006	2008
EQ-5D < 0					
n	38	18	35	36	56
Actual Mean EQ-5D score	-0.0932	-0.1281	-0.0797	-0.1251	-0.1228
Predicted mean EQ-5D score					
PI Linear	0.4342	0.3881	0.4077	0.3752	0.3827
PI Dimension	**0.1436**	**0.1171**	**0.1296**	**0.1135**	**0.0841**
2 part	0.4013	0.3561	0.3925	0.3506	0.3507
Mean Errors					
PI Linear	-0.5275	-0.5162	-0.4874	-0.5003	-0.5055
PI Dimension	**-0.2368**	**-0.2452**	**-0.2093**	**-0.2386**	**-0.2070**
2 part	-0.4946	-0.4842	-0.4722	-0.4757	-0.4735
Mean Absolute Errors					
PI Linear	0.5275	0.5162	0.4874	0.5003	0.5055
PI Dimension	**0.2368**	**0.2452**	**0.2093**	**0.2386**	**0.2074**
2 part	0.4946	0.4842	0.4722	0.4757	0.4735
0≤ EQ-5D < 0.5					
n	53	39	57	84	98
Actual Mean EQ-5D score	0.1810	0.1595	0.1552	0.1697	0.1589
Predicted mean EQ-5D score					
PI Linear	0.4971	0.4438	0.5040	0.5061	0.4735
PI Dimension	**0.4107**	**0.3793**	**0.3975**	**0.3741**	**0.3913**
2 part	0.4647	0.4186	0.4814	0.4739	0.4393
Mean Errors					
PI Linear	-0.3162	-0.2844	-0.3488	-0.3364	-0.3146
PI Dimension	**-0.2297**	**-0.2199**	**-0.2423**	**-0.2044**	**-0.2324**
2 part	-0.2838	-0.2591	-0.3263	-0.3042	-0.2804
Mean Absolute Errors					
PI Linear	0.3185	0.2863	0.3514	0.3389	0.3201
PI Dimension	**0.2440**	**0.2388**	**0.2552**	**0.2248**	**0.2458**
2 part	0.2875	0.2626	0.3290	0.3081	0.2887

Table 11: Errors across the distribution for the diabetes PI dimension models (cont'd)

Diabetes	2003	2004	2005	2006	2008
			0.5 ≤ EQ-5D < 0.75		
n	187	71	187	224	283
Actual Mean EQ-5D score	0.6550	0.6434	0.6655	0.6614	0.6554
Predicted mean EQ-5D score					
PI Linear	**0.5895**	**0.5238**	**0.6152**	**0.5835**	**0.5705**
PI Dimension	0.5631	0.5257	0.5852	0.5698	0.5563
2 part	0.5596	0.5053	0.5923	0.5626	0.5371
Mean Errors					
PI Linear	**0.0654**	0.1197	**0.0503**	**0.0780**	**0.0849**
PI Dimension	0.0919	**0.1178**	0.0803	0.0916	0.0991
2 part	0.0954	0.1381	0.0732	0.0989	0.1183
Mean Absolute Errors					
PI Linear	0.1422	0.1423	0.1037	0.1490	0.1412
PI Dimension	**0.1050**	**0.1242**	**0.0910**	**0.1007**	**0.1082**
2 part	0.1602	0.1842	0.1535	0.1772	0.1796
			EQ-5D ≥ 0.75		
n	132	54	160	161	175
Actual Mean EQ-5D score	0.8760	0.8717	0.8870	0.8792	0.8916
Predicted mean EQ-5D score					
PI Linear	0.6899	0.6516	0.7149	0.7003	0.6910
PI Dimension	**0.7807**	**0.7643**	**0.7931**	**0.7924**	**0.7915**
2 part	0.6830	0.6561	0.7417	0.6959	0.7015
Mean Errors					
PI Linear	0.1861	0.2201	0.1721	0.1789	0.2006
PI Dimension	**0.0953**	**0.1074**	**0.0940**	**0.0868**	**0.1001**
2 part	0.1930	0.2156	0.1453	0.1833	0.1901
Mean Absolute Errors					
PI Linear	0.1984	0.2235	0.1826	0.1842	0.2043
PI Dimension	**0.1016**	**0.1096**	**0.1016**	**0.0952**	**0.1063**
2 part	0.2433	0.2551	0.2082	0.2384	0.2446

6.5 Section synopsis and discussion

- None of the coefficients for the performance indicator (Survey year) were statistically significant in the condition specific PI linear models.
- Several of the coefficients for the performance indicator (Survey year) were statistically significant in the condition specific PI dimension models.
- The magnitude and statistical significance of the coefficients for the other explanatory variables were condition and health dimension specific.
- The PI linear models were the most accurate in terms of predicting the mean survey EQ-5D across all four prevalent LLTIs.
- The PI dimension models performed better across all surveys and LLTIs in terms of the mean absolute errors in the predictions.

- In general, the PI dimension models performed better across the full range of the EQ-5D index when compared in terms of the mean errors and MAEs.
- The PI dimension approach produced distributions which reflected the skewed nature of the actual EQ-5D data.
- The PI linear models predicted scores over one, covered a truncated range and did not capture the characteristics of the actual data.

The results from the PI models suggested that it may be possible to identify a variable (such as year of survey) to assess changes in mean EQ-5D scores over time. As in the previous analyses, these PI results illustrated the potential hazards associated with using a linear EQ-5D model for anything other than predicting mean EQ-5D scores. They also reiterated the earlier findings that the errors in the predicted EQ-5D scores could be substantial for values outside $0.5 \le$ EQ-5D < 0.75. Again, this finding undermines confidence in using the individual patient level predictions to obtain a ratio for a case-mix adjustment.

7. DISCUSSION

When examining changes in HRQoL over time, there are many aspects of interest. One may want to concentrate on an aggregate, single summary statistic, or examine changes in the various aspect of HRQoL, or perhaps to understand more about how HRQoL has changed within different disease areas. In all cases, the methods for doing so, using data from different populations, have to take account of changes in the case-mix. Moreover, when trying to correct for this, the structure of the data must be taken into account.

An internal document from the DH used linear regression to analyse the dependency of a summary statistic based on EQ-5D data and used the results of the analysis to determine corrections for case-mix. Linear regression is, as a tool to explore the data, and potentially also for prediction, a very valuable tool. However, while it performs well on averages, it fails to disentangle the data in detail. For that, it would need data which are normally distributed, and EQ-5D data are not normally distributed, irrespective of survey or health condition. Generally when examining skewed distributions, measures of dispersion can be more informative than a mean value, and this could be particularly relevant when considering changes over time.

In this study, the linear models performed well in terms of predicting mean EQ-5D scores but they predicted a very truncated range at the bottom of the index, and scores larger than the maximum of the EQ-5D index. They also did not perform well in comparison to the dimension models when examining the distribution of the EQ-5D index. The linear predictions did not capture the characteristics of the actual data and as such may be sub-optimal to examine potential shifts in the distribution over time, either in terms of the overall HRQoL or the individual dimensions of health. Conversely, the simulated dimension models did capture the distributions of the actual scores and could potentially be used to examine shifts in the distributions over time. While the dimension models were far more accurate than the linear models across the extremes of the index, the errors in the expected scores could also be substantial.

The errors in the individual predicted EQ-5D scores should raise concerns with regard to the appropriateness of using a case-mix adjustment that is obtained using a ratio of observed and expected scores generated on an individual level. Although an alternative method is offered in the form of a ratio generated from the totals of the observed and the expected, this does not make any adjustment for the errors in the predicted scores at the extremes of the EQ-5D index. A case-mix adjustment based on a ratio is not necessarily the most appropriate method for EQ-5D data due to the problems with fitting a statistical model which captures the relationship accurately across the full index.

Regressions which incorporate an explanatory variable representing a PI (i.e. the survey year) are suggested as a possible alternative as these do not rely on accuracy in the individual level predictions and thus may be more appropriate. While the PI beta coefficients in the linear model were not statistically significant, this was not always the case in the PI dimension models. It is possible that the PI dimension models could be improved in terms of the explanatory variables included, as the relationships reported here were specific to both condition and health dimensions.

Although the PI 2 part models did not perform particularly well in terms of either accuracy in predictions or identifying shifts over time, there is potential benefit in developing this method further.

Caveats / additional research:

Due to time constraints associated with this project, no formal assessment of any of the models was conducted. In addition, the health dimensions approach was not fully explored and there are several areas which would benefit from additional research:

1) To enable comparison with the earlier work the explanatory coefficients were retained in the models irrespective of statistical significance. Additional research to identify significant predictors specific to each of the five health dimensions could improve the results.
2) The responses to the health dimensions could be correlated and will be condition specific. An alternative that would be useful to explore would be a multivariate ordered logit model which incorporates all five health dimensions within the same structure. Although there are currently not any freely available STATA commands or do-files to generate this form of model, it may be possible to programme this in STATA.
3) Additional research to explore the 2 part model approach is recommended.
4) The assumptions underlying the ordered logistic regression models should be formally tested and alternative multinomial models estimated.

8. APPENDIX

EQ-5D SUMMARY STATISTICS

Table A1: Number of respondents with each LLTI

	All years	2003	2004	2005	2006	2008
At least one LLTI	13,540	3,397	966	2,623	3,167	3,398
Cancer	648	147	26	159	156	160
Diabetes	2,148	410	182	439	505	612
Mental disorder	1,342	320	128	200	323	371
Epilepsy	1,515	402	95	256	361	401
Eye	816	218	55	181	169	193
Ear	726	193	31	146	176	180
Stroke	4,154	949	266	953	948	1,038
COPD	2,531	621	187	495	584	644
Digestive	1,583	411	117	315	360	380
Kidney	759	196	59	149	190	165
Skin	415	112	22	88	113	80
Musculoskeletal	7,716	1,960	472	1,595	1,797	1,892
Infectious Disease	68	19	10	15	10	14
Blood	267	62	21	51	56	77
Other condition	104	16	12	20	18	38

Table A2: Numbers of respondents with any LLTI on each level of the five health dimensions

Mobility	All	2003	2004	2005	2006	2008
none	6,048	1,596	486	1,087	1,395	1,484
some	7,440	1,798	459	1,532	1,756	1,895
extreme	52	3	10	4	16	19
Anxiety	All	2003	2004	2005	2006	2008
none	8,720	2,189	489	1,838	2,047	2,157
some	4,089	1,039	387	683	929	1,051
extreme	731	169	79	102	191	190
Self-care	All	2003	2004	2005	2006	2008
none	11,033	2,839	780	2,124	2,572	2,718
some	2,346	532	151	471	552	640
extreme	161	26	24	28	43	40
Usual Activities	All	2003	2004	2005	2006	2008
none	6,454	1,655	494	1,234	1,474	1,597
some	6,154	1,512	396	1,192	1,488	1,566
extreme	932	230	65	197	205	235
Pain	All	2003	2004	2005	2006	2008
none	3,644	981	250	675	867	871
some	8,021	1,983	557	1,597	1,869	2,015
extreme	1,875	433	148	351	431	512

Table A3: **Proportions of respondents with any LLTI on each level of the five health dimensions**

Year:	2003	2004	2005	2006	2008
n	3,397	955	2,623	3,167	3,398
Mobility					
none	47	51	41	44	44
some	53	48	58	55	56
extreme	0	1	0	1	1
Self-care					
none	84	82	81	81	80
some	16	16	18	17	19
extreme	1	3	1	1	1
Usual Activities					
none	49	52	47	47	47
some	45	41	45	47	46
extreme	7	7	8	6	7
Pain					
none	29	26	26	27	26
some	58	58	61	59	59
extreme	13	15	13	14	15
Anxiety					
none	64	51	70	65	63
some	31	41	26	29	31
extreme	5	8	4	6	6
Mean EQ-5D	0.6484	0.6071	0.6395	0.6324	0.6210

Table A4: **EQ-5D scores** (respondents with 4 most prevalent LLTIs)

	2003	2004	2005	2006	2008
Musculoskeletal					
n	1960	472	1595	1797	1892
mean	0.5855	0.5255	0.5884	0.5690	0.5525
st.dev	0.3085	0.3465	0.3036	0.3182	0.3236
min	-0.3490	-0.5940	-0.4290	-0.4290	-0.5940
max	1	1	1	1	1
Stroke					
n	949	266	953	948	1038
mean	0.6126	0.5495	0.6053	0.5853	0.5905
st.dev	0.2993	0.3478	0.3078	0.3178	0.3107
min	-0.2390	-0.5940	-0.3490	-0.5940	-0.4840
max	1	1	1	1	1
COPD					
n	621	187	495	584	644
mean	0.6693	0.5901	0.6303	0.6319	0.6171
st.dev	0.3096	0.3700	0.3223	0.3370	0.3369
min	-0.3490	-0.4290	-0.2390	-0.3490	-0.4840
max	1	1	1	1	1
Diabetes					
n	410	182	439	505	612
mean	0.5955	0.5311	0.6206	0.5930	0.5722
st.dev	0.3169	0.3467	0.3182	0.3202	0.3348
min	-0.2390	-0.3490	-0.3490	-0.4290	-0.5940
max	1	1	1	1	1

Table A5: **Proportion of respondents reporting problems in the five health dimensions**
(4 most prevalent LLTIs)

	Musculoskeletal	Stroke	COPD	DM
n	7,716	4,154	2,531	2,148
	% (range)	% (range)	% (range)	% (range)
Mobility				
none	33 (32,36)	32 (30, 37)	45 (38, 51)	36 (34, 40)
some	66	68	55	63
extreme	0	1	0	1
Self-care				
none	77 (75,79)	76 (74, 78)	80 (78, 83)	77 (75, 79)
some	22	22	19	21
extreme	1	2	1	2
Usual Activities				
none	40 (38,42)	40 (38, 42)	49 (47, 51)	42(39, 45)
some	53	51	43	49
extreme	8	10	8	9
Pain				
none	13 (11, 14)	22 (19, 24)	32 (30, 36)	22 (17, 25)
some	67	63	53	61
extreme	20	15	15	17
Anxious				
none	67 (50, 71)	64 (45, 71)	62 (47, 69)	62(47,72)
some	29	32	32	33
extreme	4	4	6	5

PERFORMANCE INDICATOR MODELS

Table A6: Coefficients for the Mobility PI Dimension models

MOBILITY	Stroke	P	Diabetes	p	Musculo	p	COPD	p
Age	0.0371	<0.01	0.0440	<0.01	0.0421	<0.01	0.0472	<0.01
Deprivation								
Least Deprived	0.0351	0.78	-0.0635	0.72	-0.0129	0.88	0.0867	0.64
Very Deprived	0.2377	0.05	0.1686	0.31	0.2044	0.02	0.6538	<0.01
Most Deprived	0.3168	0.01	0.2861	0.09	0.3480	<0.05	0.3597	0.02
GHQ = medium (Base)								
GHQ low	-0.0782	0.46	-0.0828	0.58	-0.1088	0.15	0.1182	0.43
GHQ high	0.1823	0.17	0.3241	0.07	0.0951	0.33	0.2433	0.15
Smoker	0.4609	<0.01	0.0431	0.8	0.2132	0.01	0.3714	<0.01
Sickness								
< 6/14 days	0.2109	0.28	-0.4949	0.05	-0.0236	0.86	0.2532	0.28
<13/14 days	0.0426	0.82	0.0991	0.68	0.1042	0.42	0.1335	0.53
14/14 days	0.3043	0.02	0.3633	0.04	0.2297	0.01	0.5447	<0.01
Self-care	1.3896	<0.01	1.6141	<0.01	1.4136	<0.01	1.4369	<0.01
Usual activities	1.4042	<0.01	1.4210	<0.01	1.4019	<0.01	1.3991	<0.01
Pain	0.4645	<0.01	0.7456	<0.01	0.6161	<0.01	0.6661	<0.01
Anxiety	-0.3111	<0.01	-0.3215	0.01	0.0495	0.48	-0.2678	0.02
Year								
2004	-0.0689	0.73	-0.1032	0.68	0.1102	0.44	-0.2779	0.27
2005	-0.0581	0.66	0.0247	0.9	-0.0748	0.42	-0.1564	0.4
2006	0.0478	0.72	0.0277	0.88	0.1361	0.13	-0.2182	0.21
2008	-0.1124	0.38	0.1225	0.49	0.0828	0.35	-0.2243	0.19

Table A7: Coefficients for the Self-care PI Dimension models

SELF-CARE	Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age	0.0114	<0.01	0.0039	0.45	0.0145	<0.01	0.0113	0.01
Deprivation								
Least Deprived	-0.1846	0.18	-0.0336	0.86	-0.1057	0.29	-0.0729	0.74
Very Deprived	0.0447	0.70	0.1936	0.24	0.0556	0.53	0.1776	0.30
Most Deprived	0.2264	0.04	0.1139	0.47	0.2260	0.01	0.2731	0.08
GHQ = medium (Base)								
GHQ low	-0.1877	0.11	-0.1039	0.53	-0.1196	0.17	-0.0890	0.62
GHQ high	0.2500	0.02	-0.0033	0.98	0.2985	<0.01	0.2354	0.14
Smoker	-0.1024	0.40	-0.1493	0.39	0.0851	0.3	0.1826	0.21
Sickness								
< 6/14 days	-0.0546	0.77	0.1094	0.69	0.2624	0.05	0.1607	0.53
<13/14 days	0.1065	0.50	0.1639	0.45	0.2324	0.05	0.2335	0.26
14/14 days	0.1852	0.07	0.2569	0.08	0.3220	<0.01	0.4074	<0.01
Mobility	1.6221	<0.01	2.0172	<0.01	1.5265	<0.01	1.5472	<0.01
Usual activities	1.5702	<0.01	1.4896	<0.01	1.7137	<0.01	1.4242	<0.01
Pain	0.5308	<0.01	0.5120	<0.01	0.6313	<0.01	0.7923	<0.01
Anxiety	0.4385	<0.01	0.4907	<0.01	0.4126	<0.01	0.3695	<0.01
Year								
2004	0.1487	0.45	0.1211	0.64	0.1624	0.27	0.1306	0.62
2005	0.0584	0.65	0.0025	0.99	0.0755	0.44	0.1599	0.4
2006	0.0932	0.47	0.0535	0.78	0.0856	0.36	0.0559	0.76
2008	0.1515	0.22	0.1451	0.42	0.0876	0.34	0.1919	0.28

Table A8: Coefficients for the Usual Activities PI Dimension models

USUAL ACTIVITIES	Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age	0.0037	0.22	0.0059	0.15	0.0053	<0.01	0.0080	0.01
Deprivation								
Least Deprived	-0.0011	0.99	-0.0029	0.99	-0.0403	0.59	-0.0958	0.54
Very Deprived	0.1273	0.19	0.0787	0.57	0.1200	0.09	0.1284	0.34
Most Deprived	0.1258	0.2	0.3560	0.01	0.0879	0.22	0.0771	0.54
GHQ = medium (Base)								
GHQ low	-0.6777	<0.01	-0.6694	<0.01	-0.7131	<0.01	-0.7338	<0.01
GHQ high	0.3984	<0.01	0.5827	<0.01	0.2838	<0.01	0.2390	0.07
Smoker	-0.0681	0.5	-0.0325	0.82	-0.0486	0.47	-0.0613	0.6
Sickness								
< 6/14 days	0.1024	0.51	0.0476	0.83	0.3810	<0.01	0.1175	0.55
<13/14 days	0.3660	0.01	-0.0002	1	0.2726	0.01	0.3477	0.04
14/14 days	0.5698	<0.01	0.4265	<0.01	0.6517	<0.01	0.5090	<0.01
Mobility	1.5025	<0.01	1.5132	<0.01	1.4439	<0.01	1.5180	<0.01
Self-care	1.6001	<0.01	1.4445	<0.01	1.7857	<0.01	1.5043	<0.01
Pain	0.6581	<0.01	0.8335	<0.01	0.7765	<0.01	0.5927	<0.01
Anxiety	0.0640	0.37	0.1428	0.16	0.0434	0.43	0.1511	0.11
Year								
2004	-0.3935	0.02	-0.6108	0.01	-0.4210	<0.01	-0.3477	0.1
2005	-0.1447	0.18	-0.0088	0.96	-0.1643	0.04	0.0073	0.96
2006	-0.0900	0.4	-0.0109	0.94	-0.0688	0.36	-0.1235	0.38
2008	-0.1133	0.27	-0.0706	0.64	-0.1471	0.05	-0.1105	0.43

Table A9: Coefficients for the Pain/discomfort PI Dimension models

PAIN	Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age	-0.0124	<0.01	-0.0022	0.601	-0.0042	0.04	-0.0015	0.64
Deprivation								
Least Deprived	-0.0945	0.39	-0.1784	0.256	-0.2431	<0.01	-0.4534	<0.01
Very Deprived	0.0311	0.76	-0.0175	0.901	0.1514	0.05	-0.1430	0.28
Most Deprived	0.3195	<0.01	0.2793	0.044	0.1711	0.03	0.0550	0.66
GHQ = medium (Base)								
GHQ low	-0.1361	0.15	-0.1226	0.356	-0.2530	<0.01	0.0298	0.81
GHQ high	0.3151	<0.01	0.1592	0.263	0.3215	<0.01	0.4932	<0.01
Smoker	-0.0273	0.79	0.2254	0.123	0.1151	0.11	0.0875	0.44
Sickness								
< 6/14 days	0.2535	0.12	0.4024	0.077	0.1827	0.13	0.2460	0.21
<13/14 days	0.4518	<0.01	0.6305	0.001	0.3824	<0.01	0.2948	0.08
14/14 days	0.3400	<0.01	0.6939	<0.01	0.5661	<0.01	0.4348	<0.01
Mobility	0.4544	<0.01	0.7714	<0.01	0.6203	<0.01	0.7621	<0.01
Self-care	0.6617	<0.01	0.6451	<0.01	0.7212	<0.01	0.9373	<0.01
Usual activities	0.7017	<0.01	0.8803	<0.01	0.8025	<0.01	0.6513	<0.01
Anxiety	0.0914	0.21	-0.0254	0.801	0.2179	<0.01	-0.0729	0.42
Year								
2004	0.1012	0.55	0.4181	0.053	0.0709	0.59	0.4260	0.04
2005	0.3106	0.01	0.1102	0.509	0.0471	0.59	0.1014	0.49
2006	0.2007	0.07	-0.0151	0.924	0.0402	0.63	0.2108	0.13
2008	0.2213	0.04	0.0770	0.616	0.1977	0.02	0.1206	0.38

Table A10: Coefficients for the Anxiety/depression PI Dimension models

ANXIETY		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		-0.0204	<0.01	-0.0175	<0.01	-0.0077	<0.01	-0.0088	0.01
Deprivation									
Least Deprived		-0.2558	0.03	-0.0424	0.79	-0.1350	0.11	-0.1080	0.49
Very Deprived		0.0932	0.35	0.2418	0.08	0.0697	0.36	0.0315	0.82
Most Deprived		0.1792	0.07	0.2469	0.07	0.0986	0.19	0.0698	0.58
GHQ = medium (Base)									
GHQ low		-0.7305	<0.01	-0.6767	<0.01	-0.9176	<0.01	-0.8218	<0.01
GHQ high		1.6886	<0.01	1.8121	<0.01	1.8392	<0.01	1.7474	<0.01
Smoker		0.3675	<0.01	0.4188	<0.01	0.3894	<0.01	0.4947	<0.01
Sickness									
< 6/14 days		-0.0219	0.89	-0.3288	0.15	-0.0024	0.98	-0.1847	0.36
<13/14 days		0.0851	0.55	-0.1312	0.49	0.0381	0.71	-0.0576	0.73
14/14 days		-0.0590	0.53	-0.1186	0.37	-0.1067	0.14	-0.2053	0.1
Mobility		-0.4248	<0.01	-0.4297	<0.01	0.0212	0.78	-0.3865	<0.01
Self-care		0.5272	<0.01	0.6038	<0.01	0.4998	<0.01	0.6133	<0.01
Usual activities		0.0716	0.34	0.1595	0.13	0.0554	0.35	0.1675	0.09
Pain		0.0798	0.28	-0.0511	0.62	0.2062	<0.01	-0.0731	0.43
Year									
	2004	0.1564	0.33	-0.0172	0.93	0.3435	<0.01	0.3683	0.06
	2005	-0.3036	0.01	-0.4896	<0.01	-0.0996	0.24	-0.1231	0.42
	2006	-0.0324	0.77	-0.2208	0.16	-0.0485	0.55	0.0857	0.55
	2008	-0.0367	0.73	0.0172	0.91	0.0147	0.85	0.2121	0.12

PERFORMANCE INDICATOR: 2 PART MODELS

Table A11: Coefficients for the PI Probit models

FULL HEALTH		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		-0.0232	<0.01	-0.0227	<0.01	-0.0239	<0.01	-0.0278	<0.01
Deprivation									
Least Deprived		0.1055	0.17	0.0442	0.69	0.1112	0.06	0.0716	0.45
Very Deprived		-0.0698	0.36	-0.0428	0.68	-0.0989	0.11	-0.1470	0.1
Most Deprived		-0.1953	0.02	-0.1259	0.24	-0.2783	<0.01	-0.3929	<0.01
GHQ = medium (Base)									
GHQ low		0.6893	<0.01	0.6915	<0.01	0.4588	<0.01	0.5314	<0.01
GHQ high		-0.5810	<0.01	-0.5124	<0.01	-0.5196	<0.01	-0.9949	<0.01
Smoker		-0.2870	<0.01	-0.1771	0.12	-0.1916	<0.01	-0.2911	<0.01
Sickness									
< 6/14 days		-0.4714	<0.01	-0.2049	0.24	-0.3812	<0.01	-0.4771	<0.01
<13/14 days		-0.3905	<0.01	-0.5673	<0.01	-0.6249	<0.01	-0.4469	<0.01
14/14 days		-0.6281	<0.01	-0.7186	<0.01	-0.6345	<0.01	-0.6234	<0.01
Year									
	2004	0.0571	0.67	0.0271	0.88	0.0859	0.41	0.0046	0.98
	2005	0.1633	0.05	0.2447	0.05	0.0956	0.15	-0.0561	0.58
	2006	0.0311	0.71	0.1153	0.35	0.0244	0.7	-0.0461	0.63
	2008	0.0479	0.56	0.1256	0.29	-0.0590	0.37	-0.0829	0.38

Table A12: Coefficients for the PI Mobility Dimension 2 part models

MOBILITY		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		0.0414	<0.01	0.0467	<0.01	0.0435	<0.01	0.0505	<0.01
Deprivation									
Least Deprived		0.0484	0.68	-0.0297	0.86	-0.0044	0.96	0.1147	0.51
Very Deprived		0.2072	0.07	0.1502	0.35	0.1841	0.03	0.6177	<0.01
Most Deprived		0.2580	0.03	0.2000	0.22	0.3387	<0.01	0.3809	0.02
GHQ = medium (Base)									
GHQ low		-0.1834	0.07	-0.1984	0.17	-0.1192	0.11	-0.0045	0.98
GHQ high		0.0746	0.57	0.2225	0.22	0.0499	0.61	0.1585	0.35
Smoker		0.5120	<0.01	0.0586	0.73	0.2191	<0.01	0.4178	<0.01
Sickness									
< 6/14 days		0.2535	0.19	-0.4933	0.05	-0.0219	0.87	0.3084	0.19
<13/14 days		0.0127	0.95	0.1127	0.65	0.1227	0.35	0.1500	0.49
14/14 days		0.3217	0.01	0.3262	0.07	0.2115	0.02	0.5424	<0.01
Self-care		1.2978	<0.01	1.5418	<0.01	1.3415	<0.01	1.3207	<0.01
Usual activities		1.6452	<0.01	1.6061	<0.01	1.5111	<0.01	1.6426	<0.01
Pain		1.2573	<0.01	1.4245	<0.01	1.2512	<0.01	1.3746	<0.01
Anxiety		-0.1082	0.25	-0.1590	0.21	0.1245	0.08	-0.0757	0.53
Year									
	2004	-0.0924	0.63	-0.1363	0.58	0.0845	0.55	-0.2679	0.29
	2005	-0.1349	0.28	-0.0360	0.85	-0.0857	0.35	-0.1542	0.38
	2006	-0.0038	0.98	-0.0144	0.94	0.1189	0.18	-0.2214	0.19
	2008	-0.1673	0.17	0.0621	0.72	0.0657	0.45	-0.2213	0.18

Table A13: Coefficients for the PI Self-care Dimension 2 part models

SELF-CARE		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		0.0116	<0.01	0.0040	0.44	0.0146	<0.01	0.0118	0.01
Deprivation									
Least Deprived		-0.1881	0.17	-0.0343	0.86	-0.1061	0.29	-0.0737	0.74
Very Deprived		0.0436	0.71	0.1931	0.24	0.0555	0.53	0.1778	0.3
Most Deprived		0.2246	0.05	0.1119	0.48	0.2260	0.01	0.2750	0.08
GHQ = medium (Base)									
GHQ low		-0.1951	0.1	-0.1094	0.51	-0.1211	0.16	-0.0985	0.58
GHQ high		0.2459	0.02	-0.0081	0.96	0.2964	0	0.2327	0.14
Smoker		-0.1021	0.4	-0.1507	0.39	0.0853	0.3	0.1864	0.2
Sickness									
< 6/14 days		-0.0507	0.79	0.1150	0.68	0.2649	0.05	0.1689	0.51
<13/14 days		0.1075	0.5	0.1651	0.44	0.2338	0.05	0.2410	0.24
14/14 days		0.1855	0.07	0.2560	0.08	0.3220	<0.01	0.4084	<0.01
Mobility		1.7015	<0.01	2.0881	<0.01	1.5649	<0.01	1.6386	<0.01
Usual activities		1.5857	<0.01	1.5034	<0.01	1.7243	<0.01	1.4453	<0.01
Pain		0.5468	<0.01	0.5265	<0.01	0.6427	<0.01	0.8170	<0.01
Anxiety		0.4448	<0.01	0.4968	<0.01	0.4149	<0.01	0.3778	<0.01
Year									
	2004	0.1476	0.46	0.1203	0.64	0.1617	0.28	0.1304	0.63
	2005	0.0566	0.66	-0.0010	1	0.0748	0.45	0.1599	0.4
	2006	0.0926	0.47	0.0507	0.79	0.0846	0.37	0.0550	0.77
	2008	0.1512	0.23	0.1426	0.43	0.0870	0.35	0.1922	0.28

Table A14: Coefficients for the PI Usual Activities Dimension 2 part models

USUAL ACTIVITIES		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		0.0058	0.05	0.0070	0.08	0.0065	<0.01	0.0110	<0.01
Deprivation									
Least Deprived		-0.0084	0.94	0.0031	0.98	-0.0374	0.62	-0.0718	0.64
Very Deprived		0.1145	0.23	0.0706	0.6	0.1124	0.12	0.1374	0.3
Most Deprived		0.0983	0.31	0.3207	0.02	0.0870	0.23	0.0880	0.49
GHQ = medium (Base)									
GHQ low		-0.7188	<0.01	-0.7070	<0.01	-0.7146	<0.01	-0.7821	<0.01
GHQ high		0.3656	<0.01	0.5495	<0.01	0.2619	<0.01	0.2323	0.08
Smoker		-0.0594	0.56	-0.0387	0.79	-0.0459	0.49	-0.0437	0.71
Sickness									
< 6/14 days		0.1223	0.44	0.0677	0.76	0.3932	<0.01	0.1549	0.44
<13/14 days		0.3574	0.01	0.0081	0.97	0.2822	0.01	0.3761	0.03
14/14 days		0.5715	<0.01	0.4149	<0.01	0.6435	<0.01	0.5042	<0.01
Mobility		1.7853	<0.01	1.7281	<0.01	1.5833	<0.01	1.8227	<0.01
Self-care		1.5668	<0.01	1.4147	<0.01	1.7518	<0.01	1.4269	<0.01
Pain		0.8910	<0.01	1.0623	<0.01	1.0217	<0.01	0.8788	<0.01
Anxiety		0.1448	0.05	0.2311	0.02	0.0792	0.16	0.2775	<0.01
Year									
	2004	-0.3735	0.02	-0.6232	<0.01	-0.4229	<0.01	-0.3468	0.1
	2005	-0.1609	0.13	-0.0294	0.86	-0.1674	0.03	0.0024	0.99
	2006	-0.0955	0.36	-0.0214	0.89	-0.0713	0.34	-0.1164	0.41
	2008	-0.1207	0.24	-0.0924	0.53	-0.1489	0.04	-0.1084	0.43

Table A15: Coefficients for the PI Pain Dimension 2 part models

PAIN		Stroke	p	Diabetes	p	Musculo	p	COPD	p
Age		-0.0048	0.08	0.0025	0.49	0.0021	0.22	0.0067	0.01
Deprivation									
Least Deprived		-0.0870	0.37	-0.1317	0.34	-0.2075	<0.01	-0.3452	0.01
Very Deprived		0.0050	0.96	-0.0319	0.8	0.1126	0.11	-0.1225	0.3
Most Deprived		0.2475	0.01	0.1935	0.13	0.1695	0.02	0.1178	0.29
GHQ = medium (Base)									
GHQ low		-0.3061	<0.01	-0.3122	0.01	-0.2677	<0.01	-0.1833	0.09
GHQ high		0.1661	0.08	-0.0220	0.87	0.2195	<0.01	0.4245	<0.01
Smoker		0.0137	0.89	0.2275	0.08	0.1421	0.03	0.1346	0.19
Sickness									
< 6/14 days		0.3307	0.03	0.4811	0.02	0.2627	0.02	0.3763	0.04
<13/14 days		0.4634	<0.01	0.6829	<0.01	0.4527	<0.01	0.3467	0.03
14/14 days		0.3463	<0.01	0.6992	<0.01	0.5654	<0.01	0.4329	<0.01
Mobility		1.3641	<0.01	1.5518	<0.01	1.3991	<0.01	1.5875	<0.01
Self-care		0.4885	<0.01	0.4780	<0.01	0.5445	<0.01	0.6912	<0.01
Usual activities		0.9223	<0.01	1.1019	<0.01	1.0478	<0.01	0.9053	<0.01
Anxiety		0.4247	<0.01	0.3458	<0.01	0.4616	<0.01	0.3888	<0.01
Year									
	2004	0.1265	0.4	0.3983	0.04	0.0325	0.78	0.3722	0.04
	2005	0.2354	0.02	0.0292	0.85	0.0328	0.67	0.0757	0.57
	2006	0.1466	0.14	-0.0230	0.87	0.0215	0.77	0.2061	0.1
	2008	0.1761	0.07	0.0023	0.99	0.1852	0.01	0.1238	0.31

Table A16: Coefficients for the PI Anxiety/Depression Dimension 2 part models

ANXIETY		Stroke		Diabetes		Musculo		COPD	
Age		-0.0162	<0.01	-0.0149	<0.01	-0.0059	<0.01	-0.0034	0.25
Deprivation									
Least Deprived		-0.2682	0.02	-0.0129	0.93	-0.1250	0.13	-0.0435	0.77
Very Deprived		0.0740	0.45	0.2316	0.08	0.0667	0.37	0.0306	0.81
Most Deprived		0.1355	0.16	0.1818	0.17	0.0993	0.18	0.0975	0.42
GHQ = medium (Base)									
GHQ low		-0.7982	<0.01	-0.7582	<0.01	-0.9185	<0.01	-0.9390	<0.01
GHQ high		1.6529	<0.01	1.7535	<0.01	1.8110	<0.01	1.7542	<0.01
Smoker		0.3777	<0.01	0.3980	<0.01	0.3877	<0.01	0.5199	<0.01
Sickness									
< 6/14 days		0.0248	0.88	-0.2906	0.19	0.0197	0.86	-0.0883	0.65
<13/14 days		0.0639	0.65	-0.1290	0.5	0.0557	0.59	-0.0180	0.91
14/14 days		-0.0643	0.49	-0.1670	0.2	-0.1260	0.08	-0.2337	0.06
Mobility		-0.1085	0.27	-0.1639	0.22	0.1711	0.02	-0.0790	0.55
Self-care		0.4350	<0.01	0.5081	<0.01	0.4276	0	0.4204	<0.01
Usual activities		0.1436	0.06	0.2346	0.03	0.0950	0.11	0.2800	0.01
Pain		0.4181	<0.01	0.3337	<0.01	0.4675	<0.01	0.4044	<0.01
Year									
	2004	0.1726	0.27	-0.0529	0.79	0.3352	0.01	0.3668	0.05
	2005	-0.3410	<0.01	-0.5381	<0.01	-0.1218	0.15	-0.1230	0.41
	2006	-0.0627	0.56	-0.2414	0.11	-0.0622	0.44	0.1278	0.35
	2008	-0.0547	0.6	-0.0430	0.77	0.0156	0.84	0.2329	0.08

PREDICTIVE ABILITIES OF PI MODELS

Table A17: Comparing the predictive abilities of the Diabetes PI models

Diabetes	2003	2004	2005	2006	2008
n	410	182	439	505	612
Actual mean EQ-5D	0.5955	0.5311	0.6206	0.5930	0.5722
Predicted mean EQ-5D					
PI Linear	**0.5955**	**0.5311**	**0.6206**	**0.5930**	**0.5722**
PI Dimension	0.5746	0.5247	0.6002	0.5757	0.5539
2 part	0.5724	0.5167	0.6164	0.5746	0.5492
Mean Errors					
PI Linear	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
PI Dimension	0.0209	0.0064	0.0203	0.0173	0.0183
2 part	0.0231	0.0144	0.0041	0.0178	0.0208
Mean Absolute Errors					
PI Linear	0.2188	0.2342	0.1952	0.2169	0.2212
PI Dimension	**0.1341**	**0.1564**	**0.1256**	**0.1294**	**0.1388**
2 part	0.2344	0.2517	0.2216	0.2398	0.2426

Bold text = smallest error

Table A18: Comparing the predictive abilities of the Musculoskeletal PI models

Musculoskeletal	2003	2004	2005	2006	2008
n	1,960	472	1,595	1,797	1,892
Actual mean EQ-5D	0.5855	0.5255	0.5884	0.5690	0.5525
Predicted mean EQ-5D					
PI Linear	**0.5855**	**0.5255**	**0.5884**	**0.5690**	**0.5525**
PI Dimension	0.5730	0.5193	0.5737	0.5583	0.5395
2 part	0.5689	0.5154	0.5668	0.5527	0.5303
Mean Errors					
PI Linear	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
PI Dimension	0.0125	0.0062	0.0147	0.0107	0.0129
2 part	0.0167	0.0101	0.0216	0.0163	0.0222
Mean Absolute Errors					
PI Linear	0.2013	0.2249	0.1963	0.2051	0.2137
PI Dimension	**0.1308**	**0.1506**	**0.1305**	**0.1320**	**0.1410**
2 part	0.2185	0.2365	0.2160	0.2207	0.2299

Bold text = smallest error

Table A19: Comparing the predictive abilities of the Stroke PI models

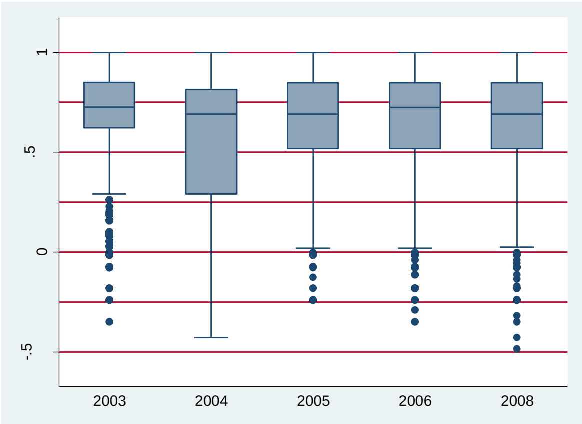
Stroke	2003	2004	2005	2006	2008
n	949	266	953	948	1,038
Actual mean EQ-5D	0.6126	0.5495	0.6053	0.5853	0.5905
Predicted mean EQ-5D					
PI Linear	**0.6126**	**0.5495**	**0.6053**	**0.5853**	**0.5905**
PI Dimension	0.5939	0.5283	0.5899	0.5721	0.5717
2 part	0.5955	0.5370	0.5911	0.5677	0.5744
Mean Errors					
PI Linear	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
PI Dimension	0.0187	0.0212	0.0154	0.0132	0.0188
2 part	0.0171	0.0125	0.0142	0.0176	0.0162
Mean Absolute Errors					
PI Linear	0.1998	0.2231	0.2061	0.2143	0.2082
PI Dimension	**0.1223**	**0.1413**	**0.1276**	**0.1368**	**0.1339**
2 part	0.2154	0.2399	0.2263	0.2344	0.2289

Bold text = smallest error

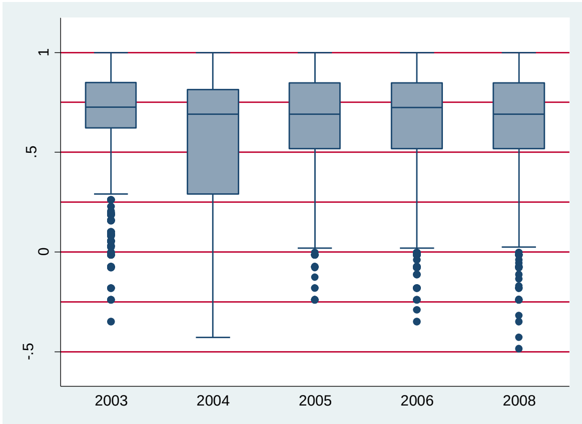
ABILITY OF PI MODELS TO IDENTIFY SHIFTS IN EQ-5D SCORES

Figure A1: Comparing actual and predicted expected EQ-5D scores COPD

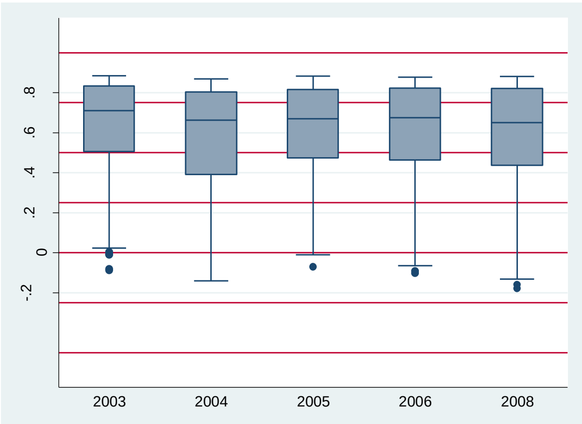
Actual EQ-5D scores COPD



PI Linear model expected EQ-5D scores COPD



PI Dimension model
expected EQ-5D scores COPD



PI 2 part model
expected EQ-5D scores COPD

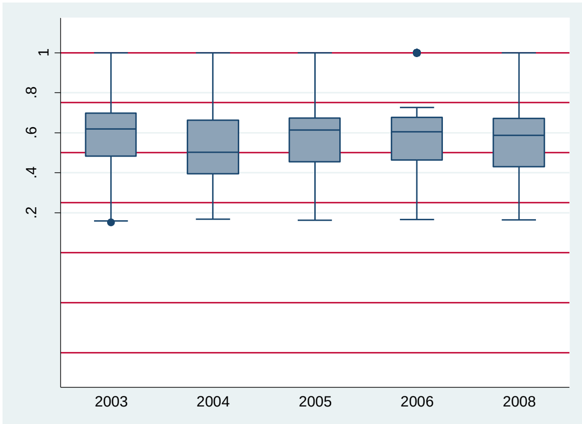
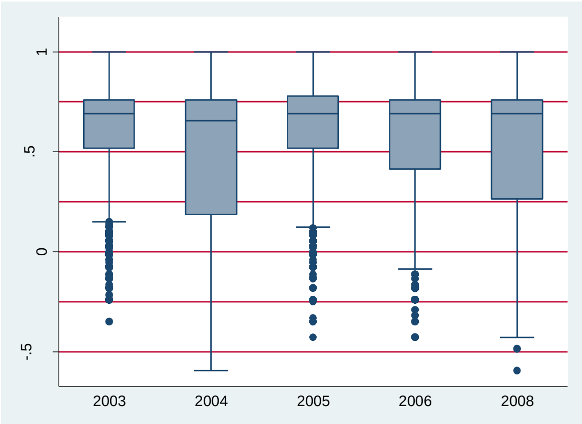
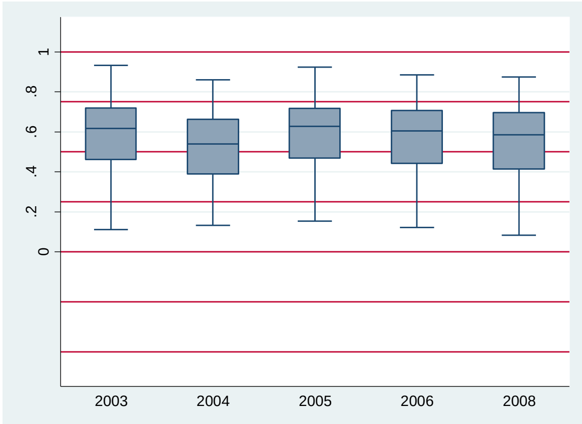


Figure A2: Comparing actual and predicted expected EQ-5D scores Musculoskeletal

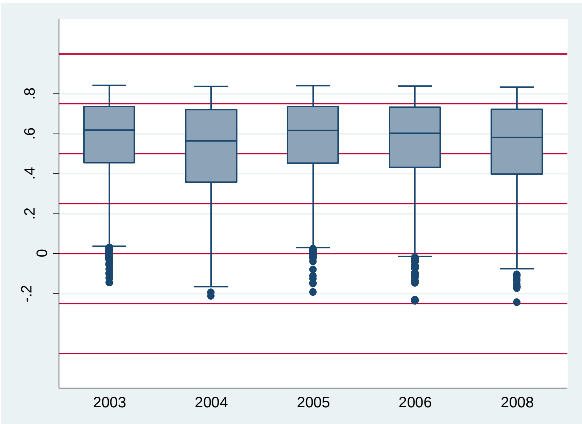
Actual EQ-5D scores Musculoskeletal



PI Linear model
expected EQ-5D scores Musculoskeletal



PI Dimension model
expected EQ-5D scores Musculoskeletal



PI 2 part model
expected EQ-5D scores Musculoskeletal

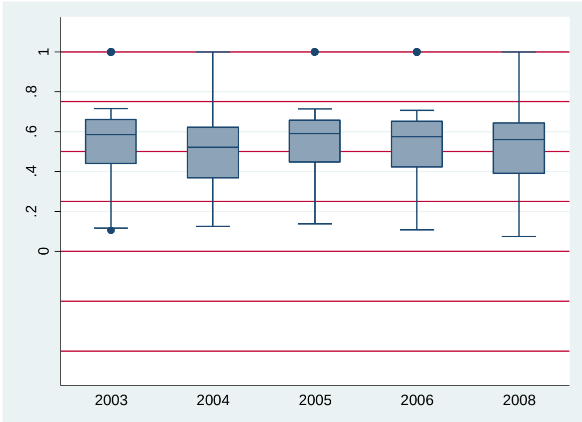
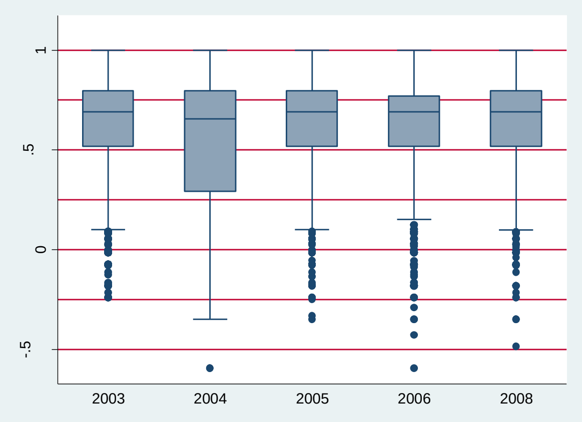
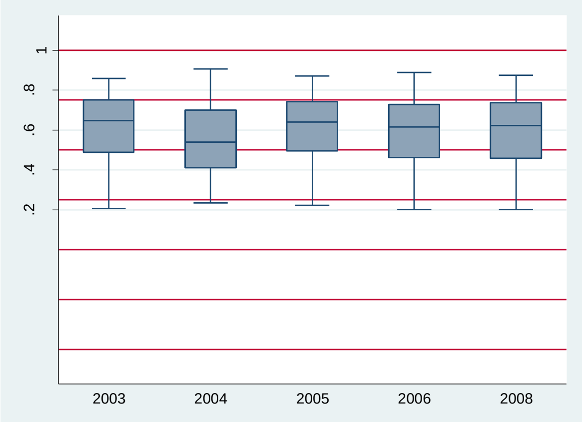


Figure A3: Comparing actual and predicted expected EQ-5D scores Stroke

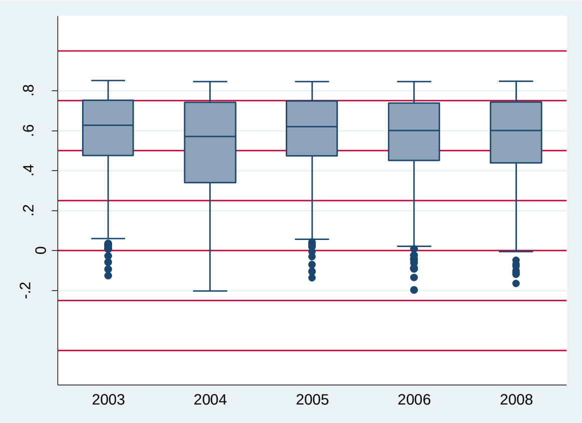
Actual EQ-5D scores Stroke



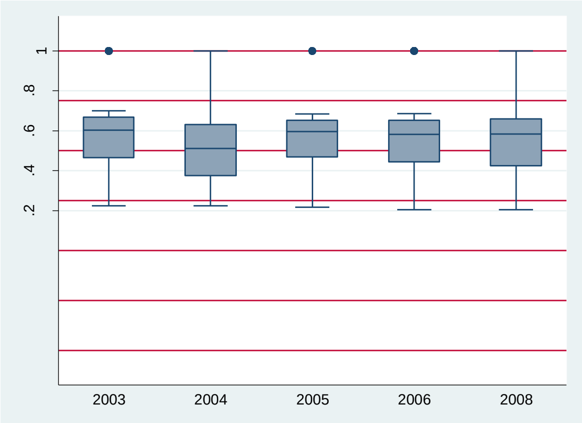
PI Linear model expected EQ-5D scores Stroke



PI Dimension model
expected EQ-5D scores Stroke



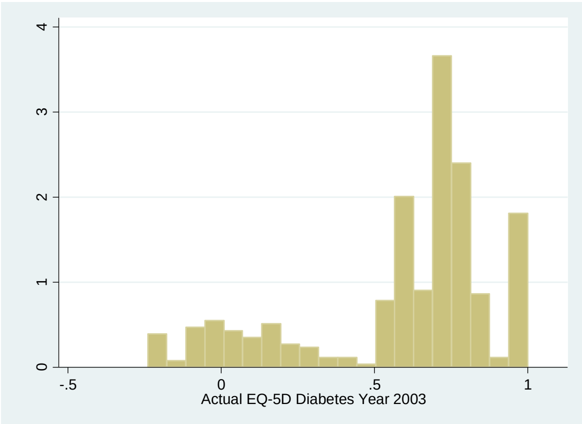
PI 2 part model
expected EQ-5D scores Stroke



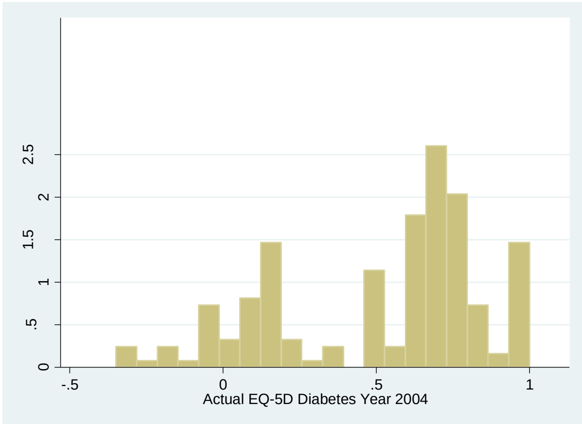
DISTRIBUTION OF ACTUAL AND EXPECTED DIABETES EQ-5D SCORES

Figure A4: Distributions of actual and expected EQ-5D scores for sub-groups with diabetes

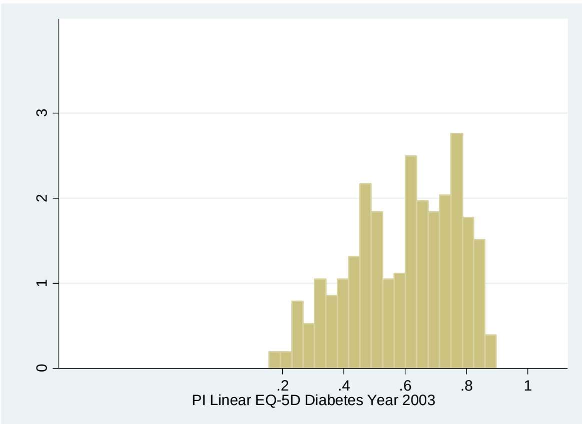
Actual Year 2003



Actual Year 2004



PI Linear model Year 2003



PI Linear model Year 2004

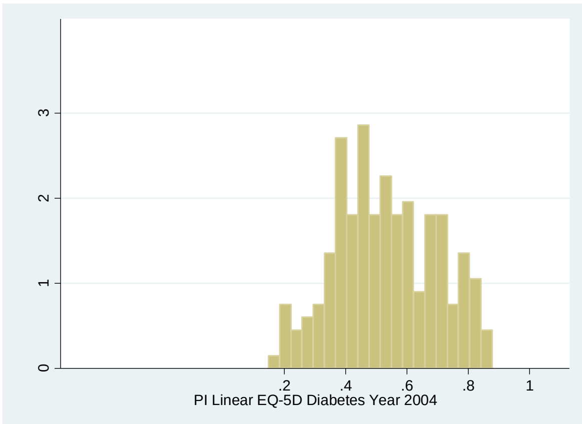
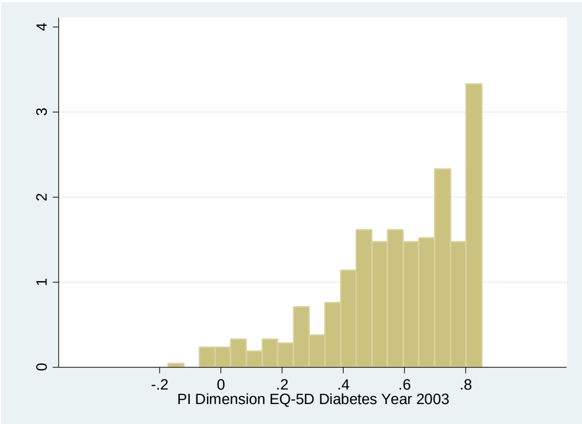
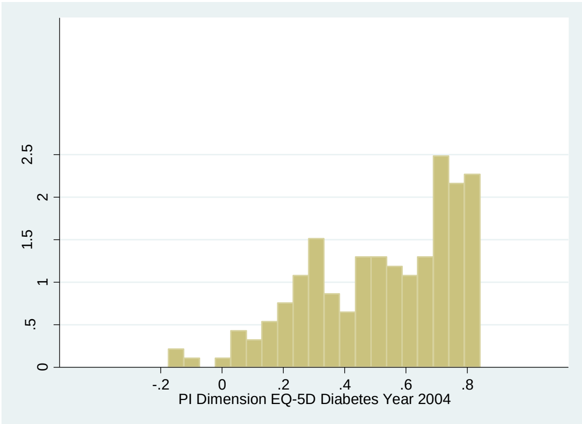


Figure A4: **Distributions of actual and expected EQ-5D scores for sub-groups with diabetes (cont'd)**

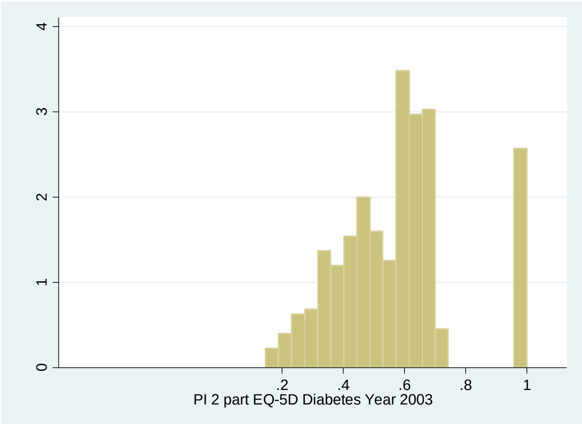
PI Dimension model Year 2003



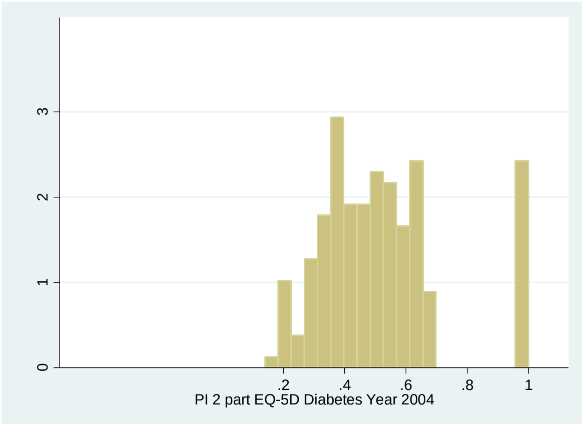
PI Dimension model Year 2004



PI 2 part model Year 2003



PI 2 part model Year 2004



PREDICTIVE ABILITY OVER EQ-5D INDEX

Table A20: Errors across the EQ-5D index for the musculoskeletal PI models

Musculoskeletal	2003	2004	2005	2006	2008	2003	2004	2005	2006	2008
	EQ-5D < 0					0.5 ≤ EQ-5D < 0.75				
n	156	59	131	167	180	919	209	776	840	886
Actual Mean	-0.0746	-0.1106	-0.0746	-0.084	-0.0924	0.6678	0.6552	0.6647	0.6654	0.6619
Predicted mean										
PI Linear	0.3962	0.3559	0.4129	0.365	0.3515	**0.5819**	**0.5327**	**0.5849**	**0.5775**	**0.5537**
PI Dimension	**0.1482**	**0.1113**	**0.1553**	**0.1292**	**0.1171**	0.5773	0.5462	0.5721	0.5716	0.5521
2 part	0.3755	0.3308	0.388	0.3439	0.3249	0.5584	0.5125	0.5585	0.5547	0.5276
Mean Errors										
PI Linear	-0.4708	-0.4665	-0.4875	-0.4489	-0.4439	**0.0859**	0.1225	**0.0798**	**0.0879**	**0.1082**
PI Dimension	**-0.2228**	**-0.2219**	**-0.2299**	**-0.2131**	**-0.2095**	0.0905	**0.109**	0.0927	0.0938	0.1098
2 part	-0.4501	-0.4414	-0.4626	-0.4279	-0.4173	0.1094	0.1427	0.1062	0.1107	0.1343
Mean Absolute Errors										
PI Linear	0.4708	0.4665	0.4875	0.4489	0.4439	0.1268	0.1435	0.1204	0.1296	0.1406
PI Dimension	**0.2228**	**0.2219**	**0.2299**	**0.2131**	**0.2095**	**0.0973**	**0.1166**	**0.0985**	**0.0981**	**0.1137**
2 part	0.4501	0.4414	0.4626	0.4279	0.4173	0.1478	0.1762	0.142	0.1502	0.1632
	0≤ EQ-5D < 0.5					EQ-5D ≥ 0.75				
n	302	84	226	285	320	583	120	462	505	506
Actual Mean EQ-5D	0.1517	0.1595	0.1606	0.1549	0.1394	0.8572	0.8685	0.8575	0.8582	0.8515
Predicted mean EQ-5D										
PI Linear	0.4893	0.4321	0.491	0.471	0.4717	0.6917	0.6617	0.6916	0.6775	0.6728
PI Dimension	**0.3986**	**0.3905**	**0.4131**	**0.3937**	**0.3849**	**0.7703**	**0.7633**	**0.7736**	**0.771**	**0.7656**
2 part	0.4673	0.4096	0.4701	0.4491	0.447	0.6896	0.685	0.6787	0.6766	0.6608
Mean Errors										
PI Linear	-0.3376	-0.2726	-0.3304	-0.3161	-0.3324	0.1655	0.2068	0.1658	0.1807	0.1787
PI Dimension	**-0.2469**	**-0.2309**	**-0.2525**	**-0.2388**	**-0.2455**	**0.0869**	**0.1052**	**0.0839**	**0.0872**	**0.086**
2 part	-0.3156	-0.2501	-0.3095	-0.2943	-0.3076	0.1676	0.1835	0.1787	0.1816	0.1907
Mean Absolute Errors										
PI Linear	0.3406	0.2791	0.3346	0.3213	0.3369	0.1744	0.21	0.1737	0.1846	0.182
PI Dimension	**0.262**	**0.2482**	**0.2715**	**0.2585**	**0.2629**	**0.0911**	**0.1064**	**0.0872**	**0.09**	**0.0875**
2 part	0.3193	0.2602	0.3144	0.3003	0.3132	0.2157	0.2239	0.2223	0.2247	0.2274

bold text = smallest error

Table A21: Errors across the EQ-5D index for the COPD PI models

COPD	2003	2004	2005	2006	2008	2003	2004	2005	2006	2008
	EQ-5D < 0					0.5 ≤ EQ-5D < 0.75				
n	33	24	35	50	55	235	61	193	200	246
Actual Mean	-0.0806	-0.1096	-0.0825	-0.0854	-0.1099	0.6619	0.6481	0.6651	0.6648	0.6532
Predicted mean										
PI Linear	0.4587	0.3806	0.4169	0.3947	0.4092	**0.6247**	0.5351	**0.6069**	**0.592**	**0.5705**
PI Dimension	**0.1669**	**0.0858**	**0.161**	**0.1569**	**0.1349**	0.5878	**0.5353**	0.5909	0.5699	0.5584
2 part	0.4265	0.3603	0.3988	0.377	0.3841	0.5821	0.5054	0.565	0.5533	0.5295
Mean Errors										
PI Linear	-0.5393	-0.4902	-0.4994	-0.4801	-0.519	**0.0372**	0.1131	**0.0581**	**0.0728**	**0.0827**
PI Dimension	**-0.2475**	**-0.1954**	**-0.2434**	**-0.2422**	**-0.2448**	0.0741	**0.1128**	0.0742	0.0949	0.0948
2 part	-0.507	-0.4699	-0.4812	-0.4623	-0.494	0.0798	0.1427	0.1001	0.1115	0.1237
Mean Absolute Errors										
PI Linear	0.5393	0.4902	0.4994	0.4801	0.519	0.1264	0.1756	0.1373	0.1349	0.1441
PI Dimension	**0.2475**	**0.1954**	**0.2434**	**0.2422**	**0.2448**	**0.091**	**0.1252**	**0.0936**	**0.1109**	**0.109**
2 part	0.507	0.4699	0.4812	0.4623	0.494	0.147	0.2188	0.1525	0.1565	0.1602
	0≤ EQ-5D < 0.5					EQ-5D ≥ 0.75				
n	78	25	77	83	94	275	77	190	251	249
Actual Mean	0.1593	0.166	0.1864	0.1698	0.1853	0.9103	0.8998	0.9061	0.9014	0.905
Predicted mean										
PI Linear	0.518	0.4613	0.477	0.5114	0.487	0.7756	0.7407	0.7554	0.7508	0.7582
PI Dimension	**0.397**	**0.432**	**0.3855**	**0.4115**	**0.3933**	**0.816**	**0.7921**	**0.8117**	**0.8086**	**0.8144**
2 part	0.4839	0.426	0.4549	0.4807	0.46	0.7665	0.7557	0.7361	0.7491	0.7504
Mean Errors										
PI Linear	-0.3587	-0.2953	-0.2906	-0.3416	-0.3017	0.1346	0.1591	0.1507	0.1506	0.1469
PI Dimension	**-0.2377**	-0.266	**-0.1991**	**-0.2417**	**-0.2079**	**0.0943**	**0.1077**	**0.0944**	**0.0928**	**0.0907**
2 part	-0.3245	**-0.26**	-0.2685	-0.3109	-0.2747	0.1438	0.1441	0.17	0.1523	0.1547
Mean Absolute Errors										
PI Linear	0.3597	0.3064	0.3029	0.3422	0.3114	0.1617	0.1645	0.1656	0.1683	0.1688
PI Dimension	**0.2517**	**0.2662**	**0.2227**	**0.2608**	**0.2307**	**0.1067**	**0.113**	**0.1058**	**0.103**	**0.1049**
2 part	0.3257	0.2731	0.2792	0.3116	0.2862	0.199	0.1944	0.2019	0.2029	0.2021

bold text = smallest error

Table A22: Errors across the EQ-5D index for the Stroke PI models

Stroke	2003	2004	2005	2006	2008	2003	2004	2005	2006	2008
	EQ-5D < 0					0.5 ≤ EQ-5D < 0.75				
n	71	31	70	73	81	457	119	455	457	499
Actual Mean	-0.0726	-0.1263	-0.0885	-0.1069	-0.0833	0.6610	0.6452	0.6644	0.6629	0.6535
Predicted mean										
PI Linear	0.4448	0.3840	0.4294	0.4213	0.3994	**0.6098**	**0.5408**	**0.5971**	**0.5818**	**0.5813**
PI Dimension	**0.1787**	**0.0970**	**0.1556**	**0.1431**	**0.1558**	0.5884	0.5390	0.5855	0.5743	0.5637
2 part	0.4219	0.3450	0.4006	0.3975	0.3745	0.5821	0.5187	0.5705	0.5619	0.5552
Mean Errors										
PI Linear	-0.5174	-0.5103	-0.5179	-0.5282	-0.4826	**0.0512**	**0.1044**	**0.0673**	**0.0811**	**0.0722**
PI Dimension	**-0.2513**	**-0.2233**	**-0.2441**	**-0.2501**	**-0.2391**	0.0725	0.1062	0.0789	0.0886	0.0898
2 part	-0.4945	-0.4713	-0.4892	-0.5045	-0.4578	0.0788	0.1265	0.0939	0.1010	0.0983
Mean Absolute Errors										
PI Linear	0.5174	0.5103	0.5179	0.5282	0.4826	0.1172	0.1368	0.1180	0.1305	0.1266
PI Dimension	**0.2513**	**0.2233**	**0.2441**	**0.2501**	**0.2391**	**0.0844**	**0.1123**	**0.0860**	**0.0955**	**0.0981**
2 part	0.4945	0.4713	0.4892	0.5045	0.4578	0.1356	0.1838	0.1530	0.1633	0.1573
	0≤ EQ-5D < 0.5					EQ-5D ≥ 0.75				
n	126	42	140	153	155	295	74	288	265	303
Actual Mean	0.1900	0.1809	0.1790	0.1631	0.1678	0.8830	0.8881	0.8877	0.8860	0.8833
Predicted mean										
PI Linear	0.5251	0.4594	0.5355	0.4992	0.5199	0.6946	0.6841	0.6948	0.6863	0.6930
PI Dimension	**0.4031**	**0.3694**	**0.4166**	**0.4073**	**0.4048**	**0.7837**	**0.7820**	**0.7865**	**0.7818**	**0.7815**
2 part	0.5015	0.4308	0.5074	0.4738	0.4934	0.6981	0.7073	0.7106	0.6787	0.7007
Mean Errors										
PI Linear	-0.3352	-0.2785	-0.3565	-0.3360	-0.3521	0.1884	0.2040	0.1929	0.1997	0.1902
PI Dimension	**-0.2132**	**-0.1885**	**-0.2376**	**-0.2442**	**-0.2370**	**0.0993**	**0.1060**	**0.1012**	**0.1042**	**0.1018**
2 part	-0.3116	-0.2500	-0.3284	-0.3107	-0.3256	0.1849	0.1807	0.1771	0.2072	0.1826
Mean Absolute Errors										
PI Linear	0.3363	0.2808	0.3581	0.3377	0.3561	0.1930	0.2087	0.1957	0.2011	0.1936
PI Dimension	**0.2281**	**0.2168**	**0.2473**	**0.2554**	**0.2464**	**0.1049**	**0.1106**	**0.1068**	**0.1082**	**0.1071**
2 part	0.3138	0.2544	0.3306	0.3121	0.3307	0.2296	0.2252	0.2277	0.2377	0.2336

bold text = smallest error

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