**TAGRA ACUTE MLC SUBGROUP Friday 15th April 2016**

**INDICATOR SELECTION RESULTS – PART 3**

**1. Background and Summary**

At the 12th meeting of the Subgroup in March 2016, results from the indicator selection process were discussed. Several decisions were made:

* Since the indicators of need will eventually be combined into a single ‘needs index’ (as the sum of the Z-scores of the indicators) for use in the NRAC formula, it was agreed that the selection process should look for the best-performing *index* options, rather than constructing indexes from the best-performing sets of *separate* variables. These two approaches give different results.
* The Dementia prescriptions variable was agreed to be excluded for the reasons stated in paper TAMLC43. It was felt that this variable was not able to represent dementia prevalence adequately since not all dementia patients – and particularly not those with the most advanced dementia – would be prescribed medication.
* The High Resource Individuals (HRI) variable was excluded due to concerns that it is not independent of the cost ratios.
* General Health should be excluded since it is highly correlated with Limiting Long-Term Illness (LLTI) (correlation = 0.92) and had only been retained because it was unclear which of General health and LLTI was the better option. It is now clear that LLTI performs better overall.
* ‘Ethnic populations with better than average health’ should be ‘inverted’, i.e. it should be changed from expressing the fraction of the population belonging to ethnic groups with better-than-average health in the ScotStat report[[1]](#footnote-1) to expressing those with *average to poor* health. This has more face validity as a needs indicator, and since it will have the same sign of coefficient (i.e. positive) as the other indicators, it might combine better with them in an index.

Further decisions on the index were postponed until the above changes had been implemented and the best 1, 2, 3 and 4-indicator index options derived anew.

The starting point for deriving the options is the updated list of retained variables:

* All cause SMR <75
* Cancer SMR <75
* Heart SMR <75
* Other SMR <70
* LLTI (counting both “yes a little” and “yes a lot” responses)
* Living alone ≥70
* Living alone ≥90
* Unpaid care ≥ 20 hours
* Education – level 2 and below
* DNA counts – fraction of all appointments
* Low birth weight births
* Long-term sick and not seeking work
* Ethnicity (counting ethnic populations with average to poor health)
* Pakistani populations
* Gypsy/traveller populations

In this paper, the best-performing index options are identified: firstly, for individual diagnostic groups (“specific” indexes); and secondly, the “common” index options that perform best across all the diagnostic groups. These results are presented in section 2. In section 3 the options for the final index are analysed in terms of explanatory and predictive power. In section 4, the decisions required are laid out, and the relevant information is summarised and evaluated in terms of the TAGRA core criteria where possible.

The purpose of this analysis is to help the Subgroup decide on the following aspects of the future Acute MLC adjustment:

* Should diagnostic groups be retained, or combined (the ‘Whole Acute’ option)?
* If diagnostic groups are retained, are specific indices for the different diagnostic groups justified?
* Which indicators should be included in the final index / indices?

**2. Identifying the best needs index options**

Figure 1 shows the overall methodology for the indicator selection process in the form of a flowchart. The methodology was originally proposed in paper TAMLC36, but has been revised following the 12th meeting, in which it was decided to look for the best-performing *index* options, rather than constructing indexes from the best-performing sets of *separate* variables.

At this stage of the process, we are concerned with step 4 onwards; the revised methodology for this part is outlined in section 2.1, and the results are presented in section 2.2.

**C:\Users\chrism29\Downloads\Index construction methodology (latest).png**

*Figure 1: Flowchart showing final agreed methodology for choosing index options.*

**2.1 Methodology**

Specific indexes

The best-performing ‘specific’ index options (for each diagnostic group) have been derived as follows:

* The best single-variable model is the variable with the highest R2 on its own for that diagnostic group, from the retained list. (Annex A shows the R2 for each of the 15 retained variables when used as a single indicator.)
* To identify the best two-variable model, all possible pairs of variables were combined into indexes and tested in regressions, and the index with the highest R2 selected.
* The same exhaustive testing was carried out to find the best 3- and 4-variable models.

Common indexes

A ‘common’ needs index is currently used for all Acute diagnostic groups, and so to be consistent with the 2007 approach, we have also identified the best candidates for a common index.

In paper TAMLC43, the common index options were reached by firstly reducing the retained variable list to a ‘restricted’ list of 8 variables, and then examining the coefficients of the variables to select the best few – as separate variables. This approach cannot be adapted to selection of combined indexes.

Instead, in this paper, the best ‘specific’ options for the different diagnostic groups are examined and the ‘common’ best 1, 2, 3 and 4-indicator models are simply taken to be those most commonly-occurring across the diagnostic groups. This has the benefit of being more transparent than the complex and lengthy analysis of the previous methodology.

**2.2 Results**

The resulting index options – the ‘top 1, 2, 3 and 4’ models as referred to previously – are shown in Table 1.

*Table 1: Best-performing index options using 1, 2, 3 and 4 variables*

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of indicators** | **Common approach** | **Whole Acute** | **Cancer** |
| **1**  **2**  **3**  **4** | LLTI  LLTI, All-cause SMR  LLTI, All-cause SMR, Ethnicity/Unpaid care/DNA  LLTI, All-cause SMR, Ethnicity, DNA | LLTI  LLTI, All-cause SMR  LLTI, All-cause SMR, Unpaid care  LLTI, All-cause SMR, Ethnicity, DNA | Cancer SMR  Cancer SMR, All-cause SMR  Cancer SMR, All-cause SMR, Ethnicity  Cancer SMR, All-cause SMR, Ethnicity, LLTI |
|  | **Heart** | **Digestive** | **Injury** |
| **1**  **2**  **3**  **4** | LLTI  LLTI, DNA  LLTI, DNA, All-cause SMR  LLTI, All-cause SMR, DNA, Unpaid care | LLTI  LLTI, All-cause SMR  LLTI, All-cause SMR, Ethnicity  LLTI, All-cause SMR, Ethnicity, DNA | LLTI  LLTI, All-cause SMR  LLTI, All-cause SMR, DNA  LLTI, All-cause SMR, Ethnicity, DNA |
|  | **Other** | **Respiratory** | **Outpatients** |
| **1**  **2**  **3**  **4** | LLTI  LLTI, All-cause SMR  LLTI, DNA, Ethnicity  LLTI, All-cause SMR, Ethnicity, DNA | LLTI  LLTI, All-cause SMR  LLTI, All-cause SMR, Unpaid care  LLTI, All-cause SMR, Ethnicity, DNA | LLTI  LLTI, Unpaid care  LLTI, Unpaid care, Ethnicity  LLTI, Unpaid care, Ethnicity, DNA |

For Cancer, Cancer SMR <75 is once again selected consistently. For all other diagnostic groups, the specific index options comprise subsets of five variables: LLTI, All-cause SMR, Unpaid care, Ethnicity, and DNA.

The single-variable model with the highest R2 was LLTI for all diagnostic groups except Cancer, for which it was Cancer SMR <75.

The most commonly-selected 2-variable index consists of LLTI and All-cause SMR – i.e., the reference model. This pair is selected for Whole Acute, Digestive, Injury, Respiratory and Other. This is therefore assumed to be the best common 2-variable index.

For the best-performing 3-variable models, the choice of the best ‘common’ option is less clear. LLTI and All-cause SMR enter into most of the specific 3-variable indexes and so should be selected into the common index. Ethnicity is used for four diagnostic groups; however, it only appears once in combination with the pair LLTI and All-cause SMR. Unpaid care and DNA each appear twice with this pair, and three times each in total. We will therefore examine three possible common 3-variable indexes: [LLTI, All-cause SMR, Ethnicity], [LLTI, All-cause SMR, Unpaid care] and [LLTI, All-cause SMR, DNA].

For the best-performing 4-variable indexes, a set consisting of LLTI, All-cause SMR, Ethnicity, and DNA is chosen for all groups except Cancer, Heart and Outpatients, so this becomes the common 4-variable model.

**3. Analysis of the index options**

In this section the performance of the different index options is examined. Section 3.1 looks at how well the different options explain variation in the 3-year cost ratios, and section 3.2 looks at how well the different options predict the future costs.

**3.1 Explanatory power: adjusted R2**

Table 2 shows the adjusted R2 values from the regressions using each of the index options.

*Table 2: Adjusted R2 for various index options*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | **Whole Acute** | **Cancer** | **Heart** | **Digestive** | **Injury** | **Other** | **Respiratory** | **Outpatients** |
| [LLTI] | 60.8% | 9.7% | 21.6% | 39.3% | 26.8% | 46.7% | 38.2% | 51.1% |
| *Best specific 1-indicator models\** | *60.8%* | *15.3%* | *21.6%* | *39.3%* | *26.8%* | *46.7%* | *38.2%* | *51.1%* |
| [LLTI, All-cause SMR] | 59.6% | 10.9% | 21.0% | 38.6% | 26.0% | 45.1% | 38.2% | 49.3% |
| *Best specific 2-indicator models\** | *59.6%* | *14.1%* | *21.3%* | *38.6%* | *26.0%* | *45.1%* | *38.2%* | *53.0%* |
| [LLTI, All-cause SMR, Ethnicity] | 60.0% | 10.7% | 19.5% | 39.3% | 23.9% | 46.3% | 37.3% | 51.5% |
| [LLTI, All-cause SMR, Unpaid care] | 61.3% | 10.6% | 21.0% | 39.5% | 24.8% | 46.7% | 38.7% | 52.0% |
| [LLTI, All-cause SMR, DNA] | 59.2% | 10.4% | 21.5% | 38.5% | 26.3% | 44.7% | 38.5% | 49.0% |
| *Best specific 3-indicator models\** | *61.3%* | *13.7%* | *21.5%* | *39.3%* | *26.3%* | *46.9%* | *38.7%* | *53.7%* |
| [LLTI, All-cause SMR, Ethnicity, DNA] | 62.5% | 10.5% | 21.6% | 40.5% | 26.2% | 47.7% | 39.7% | 51.3% |
| [LLTI, All-cause SMR, Unpaid care, DNA] | 61.7% | 10.4% | 21.9% | 39.8% | 25.9% | 46.8% | 39.6% | 51.3% |
| *Best specific 4-indicator models\** | *62.5%* | *13.2%* | *21.9%* | *40.5%* | *26.2%* | *47.7%* | *39.7%* | *53.7%* |

\* The composition of the specific models varies by diagnostic group and corresponds to the lists in Table 1.

The ‘common’ 2-variable model, LLTI + All-cause SMR, only produces higher R2 than LLTI alone for one diagnostic group: Cancer.

For the two common 3-variable models, R2 is not substantially higher than for LLTI alone either – the difference is less than 1 percentage point, or negative, except for Cancer and Outpatients with the model including Ethnicity. The model including Unpaid care shows the best performance of the three in terms of R2 overall (although the differences are small).

Because of the slight preference for Unpaid care over Ethnicity in the 3-indicator models, we have also considered an alternative common 4-indicator index that includes Unpaid care instead of Ethnicity. For both of these common 4-indicator models, R2 is generally higher than for LLTI alone. Naturally, the model including Ethnicity (which was selected for most diagnostic groups in the exhaustive testing) performs better, with an increase of more than 1 percentage point in R2 for Whole Acute, Digestive, Respiratory and Other, compared to using LLTI alone.

For the diagnostic group Cancer, as before, R2 is generally higher when using its specific index options than when using the common models – although for one of the 3-indicator common models [LLTI, All-cause SMR, Ethnicity], the R2 is just as high as for the specific model. For other instances where the specific and common options differ, the R2 is either the same or only slightly higher.

**3.2 Predictive power: RSS**

*Predictive* power is arguably more important than *explanatory* power, since the MLC adjustment is used to predict cost ratios in the year of allocation. To evaluate the models in predictive mode, predicted cost ratios are generated. These predictions are then compared with a 1-year cost ratio based on 2014/15 data. The 2014/15 cost ratio represents the ‘future’ observation which the model would be trying to predict.

Predicted cost ratios are calculated in the same way as in the NRAC formula: the coefficient of the needs index is obtained through a regression including the supply model, but the supply variables are not used in the prediction. In the case of Outpatients, the prison dummy variable (introduced in paper TAMLC43) is included in both the regression and the prediction.

As before, comparison of predictions with observations is done using the residual sum of squares (RSS): this is the sum of the squared differences between the predictions and the observations. Low RSS values indicate that the observations are relatively close to the predictions.

The RSS values are given in Table 3.

*Table 3: RSS obtained from comparing predictions derived from the index options with the 2014/15 cost ratios. Lower values indicate the predictions are closer to the observed values.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | **Whole Acute** | **Cancer** | **Heart** | **Digestive** | **Injury** | **Other** | **Respiratory** | **Outpatients** |
| [LLTI] | 355 | 3467 | 4015 | 2160 | 2861 | 821 | 3499 | 417 |
| *Best specific 1-indicator models (based on R2)\** | *355* | *3554* | *4015* | *2160* | *2861* | *821* | *3499* | *417* |
| [LLTI, All-cause SMR] | 368 | 3471 | 4028 | 2203 | 2868 | 840 | 3547 | 422 |
| *Best specific 2-indicator models (based on R2)\** | *368* | *3519* | *4000* | *2203* | *2868* | *840* | *3547* | *416* |
| [LLTI, All-cause SMR, Ethnicity] | 382 | 3490 | 4073 | 2150 | 2929 | 834 | 3614 | 424 |
| [LLTI, All-cause SMR, Unpaid care] | 362 | 3475 | 4033 | 2165 | 2884 | 824 | 3535 | 417 |
| [LLTI, All-cause SMR, DNA] | 353 | 3454 | 4008 | 2193 | 2864 | 833 | 3500 | 413 |
| *Best specific 3-indicator models (based on R2)\** | *362* | *3530* | *4008* | *2150* | *2864* | *818* | *3535* | *426* |
| [LLTI, All-cause SMR, Ethnicity, DNA] | 351 | 3465 | 4036 | 2126 | 2894 | 808 | 3504 | 412 |
| [LLTI, All-cause SMR, Unpaid care, DNA] | 346 | 3458 | 4014 | 2155 | 2869 | 814 | 3477 | 410 |
| *Best specific 4-indicator models (based on R2)\** | *351* | *3499* | *4014* | *2126* | *2894* | *808* | *3504* | *410* |

\* The composition of the specific models varies by diagnostic group and corresponds to the lists in Table 1.

The ‘common’ 2-variable model, LLTI + All-cause SMR, produces higher RSS (i.e. poorer predictions) than LLTI alone, for all diagnostic groups. This is in agreement with the R2 results.

For the first two common 3-variable models, RSS is worse than that for LLTI alone, for almost all diagnostic groups. The third 3-variable model including DNA is the best of the three in terms of RSS, contrary to the R2 results. However, its performance is still poorer than LLTI alone for 4 diagnostic groups.

For the common 4-variable models, the predictions are more often an improvement over those from the LLTI-alone model, but the gains in predictive power are not large. The model including Unpaid care produces better RSS than the model with Ethnicity, although its R2 performance was lower.

Once again, the specific variables for Cancer perform less well in predictive mode than the common index options. As explained in paper TAMLC43, it is very likely that some of the cancer deaths counted in this variable were associated with Acute healthcare costs prior to death that are reflected in the cost ratios used to fit the model. (The Cancer SMR variable was based on deaths between April 2009 and March 2014; the cost ratios use costs and activity from April 2011 to March 2014.) This might mean that Cancer SMR explains past costs better than it predicts future costs.

For other instances where the specific and common options differ, the RSS is mostly either the same or only slightly lower.

**4. Decisions required**

In this section, the decisions required are laid out, and the relevant information from the preceding sections is summarised and evaluated in terms of the TAGRA core criteria where possible.

The decisions required are:

1. Should we retain the diagnostic groups, or apply the MLC adjustment to the Acute care programme as a whole (‘Whole Acute’ option)? (Section 4.1)
2. If we retain the diagnostic groups, should we use a specific index for each diagnostic group, or a common index for all groups? (Section 4.2)
3. Which indicators should be included in the final model? Are there non-statistical reasons to prefer some variables over others? (Section 4.3)

**4.1 Diagnostic groups vs Whole Acute**

To see whether separate diagnostic groups or the ‘Whole Acute’ option give better predictions, the separate diagnostic-group predictions must be aggregated to the Whole Acute level, to be compared with the predictions done using the ‘Whole Acute’ option. The aggregation has been done in the same way as in the NRAC formula: by summing the predicted ‘actual’ cost and the expected cost across the diagnostic groups, then dividing one by the other to produce an Acute predicted cost ratio.

The predictions – from both the aggregated diagnostic groups and from the Whole Acute analysis – are then compared with the 2014/15 Whole Acute cost ratio, using RSS as before. No substantial differences in RSS were found between diagnostic groups and the Whole Acute option, for any index option. Some representative examples are shown in Table 4.

Table 5 shows the coefficient of the needs index (i.e. the slope of the fitted line) across the diagnostic groups, for some of the index options (the same pattern was observed for all other options). There are some consistent differences between the diagnostic groups, with Respiratory, Injury, Digestive and Heart having generally higher coefficients and Outpatients and Cancer having the lowest coefficient values. This shows that the strength of the relationship between the needs index and the cost ratios varies between diagnostic groups – although this does not mean that separate modelling improves the predictions (Table 4).

For reference, Table 6 shows the activity and expenditure within each diagnostic group.

**Q: The Subgroup is asked to decide between retaining the diagnostic groups, or carrying out the Acute MLC adjustment at the whole care programme level.** Table 7 examines the arguments in terms of the TAGRA core criteria.

*Table 4: RSS analysis for Whole Acute vs. the aggregated predictions from separate diagnostic groups, for four example index options. Lower RSS indicates better predictive performance.*

|  |  |  |
| --- | --- | --- |
| **Model** | **RSS using diagnostic groups** | **RSS using ‘Whole Acute’ option** |
| [LLTI] | 355 | 355 |
| [LLTI, All-cause SMR] | 368 | 368 |
| [LLTI, All-cause SMR, Unpaid care] | 362 | 362 |
| [LLTI, All-cause SMR, Ethnicity, DNA] | 351 | 351 |

*Table 5: Coefficients by diagnostic group for four example index options*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Whole Acute** | **Cancer** | **Heart** | **Digestive** | **Injury** | **Other** | **Respiratory** | **Outpatients** |
| [LLTI] | 0.172 | 0.084 | 0.222 | 0.224 | 0.231 | 0.188 | 0.348 | 0.076  (prison dummy 0.201) |
| [LLTI, All-cause SMR] | 0.090 | 0.054 | 0.116 | 0.117 | 0.120 | 0.097 | 0.185 | 0.037  (prison dummy 0.238) |
| [LLTI, All-cause SMR, Unpaid care] | 0.067 | 0.038 | 0.084 | 0.087 | 0.085 | 0.073 | 0.136 | 0.030  (prison dummy 0.245) |
| [LLTI, All-cause SMR, Ethnicity, DNA] | 0.061 | 0.034 | 0.078 | 0.081 | 0.080 | 0.067 | 0.126 | 0.027  (prison dummy 0.228) |

*Table 6. Activity and expenditure by Acute Inpatient diagnostic group, and for Outpatients, in 2013/14.*

|  |  |  |
| --- | --- | --- |
| **Diagnostic group** | **2013/14 Number of episodes** | **2013/14 Actual spend in millions** |
| Cancer | 199,940 | £414m |
| Heart | 157,121 | £404m |
| Digestive | 189,768 | £343m |
| Injury | 124,769 | £407m |
| Other | 727,869 | £1,368m |
| Respiratory | 135,354 | £291m |
| Outpatients | 1,466,760 | £769m |
| **Total** | **3,001,581** | **£3,997m** |

*Table 7. TAGRA core criteria evaluation for use of diagnostic groups.*

|  |  |
| --- | --- |
| **Equity** |  |
| **Practicality** | Switching to Whole Acute would be easier to maintain in the long term, but would require some work to implement the change |
| **Transparency** |  |
| **Objectivity** | RSS results suggest it makes no difference either way |
| **Avoiding Perverse Incentives** |  |
| **Relevance** |  |
| **Stability** |  |
| **Responsiveness** | RSS results suggest it makes no difference either way |
| **Face Validity** | Coefficients of index differs systematically between diagnostic groups in ways that are explainable |

**4.2 Specific vs common indicator sets**

If the Subgroup decides to retain diagnostic groups, then there is a further decision to be made on whether to use the specific indexes derived for the separate diagnostic groups or whether to adopt the results of the common index approach.

Many of the best specific options are identical to the best common option (Table 1), and apart from Cancer (which is discussed below), all common and specific options are combinations of the same five variables: LLTI, All-cause SMR, Unpaid care, Ethnicity and DNA. This suggests allowing the needs index to vary between condition groups has resulted more in random variation than in significant differences being identified between the groups.

Where the specific index does differ from the common one, the predictive power does not seem to be substantially higher using the specific index (Table 3). This is true even for Cancer, which had consistently higher R2 for its specific index options (Table 2); these indexes actually perform slightly *less* well than the common indexes in predictive mode (although the difference is quite small). As noted previously, this could be because the Cancer SMR <75 variable is closely related to the past Cancer cost ratios (due to temporally overlapping data) and may be less closely related to *future* cost ratios.

In conclusion, there is no real evidence that different condition groups have different needs drivers (at least, from the set of candidate variables analysed in this review), nor that specific indexes will perform better over the long term and justify the extra complexity.

**Q: If diagnostic groups are retained, AST propose that the ‘common index’ approach is retained also. The Subgroup is asked to decide whether there is justification to use specific indices for some, or all, diagnostic groups.** Table 8 evaluates the arguments using the TAGRA core criteria.

*Table 8. TAGRA core criteria evaluation for common vs specific index approaches.*

|  |  |
| --- | --- |
|  | **Arguments for (+) and against (-) diagnostic group-specific indexes:** |
| **Equity** |  |
| **Practicality** | - It is more practical to use a common index |
| **Transparency** |  |
| **Objectivity** | - Specific variables do not result in substantially better predictions |
| **Avoiding Perverse Incentives** |  |
| **Relevance** | +/- Cancer SMR has relevance to Cancer costs, but may be poorer at predicting future cancer costs than at explaining past cancer costs due to the strong connection between past costs and eventual cancer deaths |
| **Stability** |  |
| **Responsiveness** | +/- In principle, specifically-selected variables should perform better, but this is also subject to over-fitting |
| **Face Validity** | - Many of the specific options are the same as the common options, and apart from Cancer, no specific options are radically different |

**4.3 Which components should be included in the index?**

The best-performing common index options, in terms of both R2 and RSS, are:

[LLTI]

[LLTI, All-cause SMR, Unpaid care, DNA]

[LLTI, All-cause SMR, Ethnicity, DNA]

The statistical results indicate that LLTI alone performs well, and the performance cannot be improved by adding a second variable to the index. Only by adding a further *three* variables is the performance consistently improved (across diagnostic groups) in terms of both R2 and RSS.

There may be non-statistical reasons to prefer some variables over others. All-cause SMR and DNA come from continuously-recorded data, and could therefore be updated as frequently as desired; whereas LLTI, Unpaid care and Ethnicity are derived from census data, which means updates would only be available every 10 years. For LLTI this might not matter much, since it relates to long-term health conditions. On the other hand, demographics (such as ethnicity) might be expected to change more rapidly than can be captured adequately by a 10-yearly census.

**Q: The Subgroup is asked to consider the question of how many (and which) indicators to include in the final index(es).** Table 9 examines the arguments in terms of the TAGRA core criteria.

*Table 9. TAGRA core criteria evaluation for different variable combinations.*

|  |  |
| --- | --- |
| **Equity** | Equity would perhaps favour either of the two 4-variable models over LLTI alone, since these models can pick up need relating to deprivation (DNA), and unpaid caregiving or ethnicity |
| **Practicality** | A model with fewer indicators would be more practical to implement and maintain |
| **Transparency** |  |
| **Objectivity** | The statistical evidence favours either LLTI alone, or a 4-indicator model |
| **Avoiding Perverse Incentives** | Using DNA counts as part of resource allocation could be seen as “rewarding” high DNA rates |
| **Relevance** | All variables have a strong theoretical/intuitive link to healthcare need  DNA is perhaps a stronger proxy measure of deprivation than any of the other variables |
| **Stability** |  |
| **Responsiveness** | All-cause SMR and DNA would be more responsive to change than the other variables which are derived from a census every 10 years |
| **Face Validity** | DNA would need careful presentation to not be mis-interpreted |

**5. Next steps**

This work concludes the methodology outlined in Figure 1. Once the index or indexes are chosen, the next step will be to more fully evaluate the performance of the potential new model, including analysis across different urban-rural settings and age groupings. This will be presented at the May meeting.

**Annex A: R2 for individual-variable models**

*Table A.1: R2 for each of the variables in the retained variable list, when it is used as the only indicator (along with the supply model and prison dummy variable). Highest R2 is shown in bold.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Whole Acute** | **Cancer** | **Heart** | **Digestive** | **Injury** | **Other** | **Respiratory** | **Outpatients** |
| All cause SMR<75 | 48.1% | 11.1% | 15.8% | 32.5% | 19.5% | 36.0% | 31.1% | 45.7% |
| Cancer SMR <75 | 33.1% | **15.3%** | 8.2% | 23.9% | 9.3% | 24.0% | 18.5% | 43.7% |
| Heart SMR <75 | 34.3% | 8.0% | 11.3% | 24.8% | 12.5% | 26.9% | 21.4% | 43.1% |
| Other SMR <70 | 27.1% | 7.3% | 7.0% | 21.2% | 7.7% | 22.4% | 16.8% | 41.7% |
| LLTI | **60.8%** | 9.7% | **21.6%** | **39.3%** | **26.8%** | **46.7%** | **38.2%** | **51.1%** |
| Living alone ≥70 | 19.5% | 6.9% | 3.1% | 18.1% | 4.1% | 16.0% | 10.7% | 40.9% |
| Living alone ≥90 | 19.0% | 7.1% | 3.3% | 17.7% | 3.5% | 15.4% | 10.6% | 40.6% |
| Unpaid care ≥20 | 43.2% | 8.5% | 12.3% | 30.4% | 13.0% | 33.8% | 25.8% | 51.0% |
| Education | 20.5% | 7.0% | 3.4% | 18.2% | 4.2% | 16.7% | 11.1% | 41.8% |
| DNA counts | 44.7% | 8.4% | 16.2% | 31.2% | 19.1% | 33.9% | 29.5% | 45.6% |
| Low birth weight births | 20.0% | 7.0% | 3.4% | 18.2% | 3.8% | 16.8% | 11.3% | 40.6% |
| Long term sick and not seeking work | 19.2% | 7.0% | 3.2% | 17.7% | 3.5% | 15.5% | 10.9% | 40.6% |
| Ethnicity (populations in ethnic groups with average to poor health) | 25.4% | 7.4% | 4.5% | 21.5% | 5.1% | 21.0% | 13.9% | 44.6% |
| Pakistani populations | 19.9% | 7.1% | 3.4% | 18.6% | 4.1% | 16.0% | 11.0% | 40.9% |
| Gypsy/Traveller populations | 19.4% | 7.0% | 3.4% | 17.9% | 4.3% | 15.8% | 11.2% | 40.5% |

1. <http://www.gov.scot/Publications/2015/08/7995/downloads> [↑](#footnote-ref-1)