



Neurological National Audit Programme - Mortality Indicator Risk Adjustment Methodology

1. Analysis Period

Data on all neurosurgical Finished Consultant Episodes (FCE) were extracted from Hospital Episode Statistics (HES) for the five years from 1 April 2014 to 31 March 2019.

2. Data Selection

This analysis includes only adult patients where the age was greater than 17 years at the date of admission and episodes with admissions codes that represent elective procedures.

3. Case Attribution

The Finished Consultant Episodes were filtered to ensure that mortalities were only assigned to the consultant listed on the episode immediately prior to the mortality date.

4. Outcome Measure

The outcome measure modelled was all mortality occurring within 30 days of the final surgery within an episode.

5. Risk Adjustment Model

5.1 Model Selection

All potential adjustment models were considered against a baseline adjustment model that utilised only patient age and truncated primary diagnosis code. Models were assessed by the metric of area under the curve of the receiver-operator characteristic. This metric was calculated for each model variant with 10-fold cross validation. The final adjustment model achieved an Area Under Curve (AUC) score of 92.65.

5.2 Model Variables

The final adjustment model has risk of mortality within 30 days of final surgery adjusted by the following variables:

- Age at time of admission (integer).
- Truncated primary diagnosis code (3-character categorical variable).
- Admission source (binary variable representing admission from another institution or the patient's home).

- IMD04 (numeric variable).
- IMD04HD (numeric variable).
- 8 principal components representing > 50% of the variance from among 245 2-character truncated categorical diagnosis codes (8 numeric variables).

6. Outlier Detection

Expected mortality was calculated on a per-observation basis and aggregated to provide both the trust and consultant level analyses. The Poisson test was used to determine the p-values for the actual versus expected number of mortalities for the aggregated observations. Any observation with missing data from among the model variables was removed from the final outlier detection calculation.