DEFAULT IMPUTATION, MULTIPLE IMPUTATION AND LATENT CLASS IMPUTATION FOR PAEDIATRIC AUDIT DATA

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The Paediatric Index of Mortality (PIM) [1] is mortality risk-adjustment tool that estimates the expected probability of death of children admitted to Paediatric Intensive Care based on simple presenting physiological measurements and limited diagnostic information. It is used to compare risk-adjusted mortality between paediatric intensive care units. It was first developed in 1997 using a logistic regression of mortality upon these physiological variables derived from a dataset of 5000 admissions in the UK and Australia and was updated with new coefficients and additional diagnostic classification in 2001 to produce PIM 2 [2]. Improvement in clinical care means that PIM over-predicts mortality in more recent datasets and this under-calibration is documented in the literature.

The Paediatric Intensive Care Audit Network (PICANet) is a national audit of paediatric intensive care with data on over 68, 000 admissions to UK PICUs since 2002. This large dataset provides the opportunity to recalibrate PIM 2 and to explore other aspects of this risk-adjustment algorithm, including the treatment of missing data.

Default imputation has been used to deal with missing values when calculating PIM and PIM 2: data items that are missing or measurements that were never made, for whatever reason, are replaced by their normative value. Recent work has shown that a multiple imputation might give better results. We recalculated PIM on the PICANet dataset with the default imputation and with multiple imputation of m=5 datasets. The results of the m separate regressions are combined to give the final parameters. This method allows for uncertainty in the missing values.

Both methods provide good discriminatory power (ROC area = 0.79 for default imputation and ROC area = 0.80 for the multiple imputation). However, there is a lack of calibration for the default imputation (Hosmer–Lemeshow [3] goodness-of-fit test p<0.001, χ^2 = 52.3, df = 8) although the model calculated with the multiple imputation calibrates well (Hosmer–Lemeshow goodness-of-fit test p=0.12, χ^2 = 12.7, df = 8). Hence multiple imputation to recalibrate PIM is preferred.

Latent class imputation was then considered as an extension to multiple imputation. A mixture model that incorporates the principles of multiple imputation has been developed where the prediction equations may vary across latent classes. Membership of a specific latent class might underlie the reason for missingness: for example physiological measurements might not be recorded if the patient is either too ill, or is so well that the measurement is not deemed necessary. Results from this new approach will be presented.

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[3] Hosmer DW, Lemeshow S Goodness of fit tests for the logistic regression model. Statistics in Medicine 1997; 16: 965–980 .