Updated PRAiS logistic regression risk model

Probability of death within 30 days following paediatric cardiac surgery $= \frac{1}{1+e^{-Z}}$, where

$$Z = -4.450 + 0.080 * age - 0.039 * weight + \sum_{i=1}^{39} B_i X_i \ .$$

Parameters $i = 1-39$ are tabulated below along with their corresponding regression coefficients, B_i, and the condition that must be satisfied for $X_i = 1$ ($X_i = 0$ otherwise). Note that patient age must be in units of years and patient weight in units of kilograms. The model was developed using records for patients **under 16 years old**.

i	$X_i = 1$ if condition satisfied ($X_i = 0$ otherwise)	B_i
1	Specific Procedure = Anomalous coronary artery repair	1.191
2	Specific Procedure = Aortic valvotomy	1.824
3	Specific Procedure = Arterial switch (for isolated transposition)	0.038
4	Specific Procedure = Arterial shunt	2.580
5	Specific Procedure = Arterial switch + VSD closure	0.823
6	Specific Procedure = ASD repair	-14.397
7	Specific Procedure = Atrioventricular septal defect (partial) repair	1.073
8	Specific Procedure = Aortic Valve Replacement - non Ross	-14.673
9	Specific Procedure = Aortic valve replacement - Ross	-14.847
10	Specific Procedure = Atrioventricular septal defect (complete) repair	1.426
11	Specific Procedure = Bidirectional cavopulmonary shunt	0.950
12	Specific Procedure = Fontan procedure	0.230
13	Specific Procedure = Heart Transplant	2.558
14	Specific Procedure = Interrupted aortic arch repair	1.711
15	Specific Procedure = Isolated coarctation repair	0.924
16	Specific Procedure = Isolated Pulmonary artery band	2.065
17	Specific Procedure = Low volume group	2.882
18	Specific Procedure = Mitral valve replacement	3.106
19	Specific Procedure = No specific procedure	1.943
20	Specific Procedure = Norwood procedure (Stage 1)	1.985
21	Specific Procedure = PDA ligation (surgical)	1.087
22	Specific Procedure = Pulmonary atresia VSD repair	2.319
23	Specific Procedure = Pulmonary valve replacement	1.880
24	Specific Procedure = Rastelli procedure	1.799
25	Specific Procedure = Repair of total anomalous pulmonary venous drainage	1.799
26	Specific Procedure = Subvalvar aortic stenosis repair	1.797
27	Specific Procedure = Supravalvar aortic stenosis repair	2.422
28	Specific Procedure = Tetralogy repair	1.146
29	Specific Procedure = Truncus arteriosus repair	2.271
30	Specific Procedure = VSD Repair	0.091
31	Procedure Type = Bypass	0.388
32	Diagnosis group = Low risk	-0.591
33	Diagnosis group = Medium risk	0.167
34	Diagnosis group = High risk	0.424
35	Not identified as univentricular heart	-0.644
36	No recorded non-Down's co-morbidities	-0.498
37	Age group = Child	-0.903
38	Age group = Infant	0.139
39	Age group = Neonate	0.764

We note that caution is needed when interpreting individual coefficients as these are not clinically meaningful when taken in isolation of the other risk factors. The predicted risk comes from the *combination* of procedure, age, weight, severity of diagnosis and co-morbidity information.

The original risk model was published in: Crowe, S, Brown, K, Pagel, C, Muthialu, N, Cunningham, D, Gibbs, J, Bull , C, Franklin, R, Utley, M, Tsang, V (2012). Development of a diagnosis and procedure based risk model for 30-day outcome following paediatric cardiac surgery, Journal of the Thoracic and Cardiovascular Surgery, doi:10.1016/j.jtcvs.2012.06.23. The original PRAiS risk model was developed on a subset of national CCAD data from 2000-2010 and then tested on a pristine validation set. It was also developed using the 2010 CCAD specific procedure algorithm. For this update, we have recalibrated the model parameters on the full 2007-2010 CCAD data set using the most recent 2012 CCAD specific procedure algorithm.

We note that this recalibrated version has not been tested in a pristine data set, but that only the value of the model parameters changed and not the risk factors included. Recalibration on the full data has inevitably helped redress an observed imbalance in neonatal outcomes between the original model development data set and the validation data set. As with any risk model, its performance in prospective data cannot be guaranteed.

NOTE: In our implementation of the risk model we set the minimum risk for an episode to be 0.1% (0.0001). This is because there were no deaths for some combinations of risk factors in the historical data from 2007-2010 leading to an estimated risk of 0%. We do not consider this to have clinical face validity and so have specified a minimum risk of 0.1% for such episodes (in the long run, 1 death expected in 1000 episodes).

Age Band Classification:

Neonate is defined as less than or equal to 30 days old.

Infant is defined as between 31 days and one year old inclusive.

Child is defined as older than a year and less than 16 years old.