

## SCOAP 2009 Risk-Adjustment

Risk-adjustment in SCOAP is based on the development of predictive models using statistical methods. The methods described here are adapted from those methods utilized by COAP (Clinical Outcomes Assessment Program, a program of the Foundation for Healthcare Quality). The goal of risk-adjustment is to normalize reported hospital outcome rates based on patient population demographic and clinical characteristics, facilitating more appropriate comparisons.

SCOAP collects a large amount of patient data not all of which is included in the current version of the predictive models. Elements evaluated for inclusion in the logistic regression models are selected a priori. Elements retained in the models satisfy statistical significance criteria or contribute to the face validity of the predictive model despite borderline statistical significance. SCOAP risk-adjustment is a dynamic process revisited quarterly. All variables get reconsidered each time using a non-parsimonious exploration model.

The elements and coefficients of logistic regression models are used to calculate the probability of dichotomous outcomes such as mortality and operative re-intervention for each patient. A logit value is calculated for each patient from the model:

$$\text{Logit}(p) = \_cons + \text{coefficient1}(\text{variable1}) + \text{coefficient2}(\text{variable2}) + \dots + \text{coefficientX}(\text{variableX})$$

The estimated probability is calculated using the logit:

$$\text{Probability of Event (PE)} = e^{\text{logit}} / (1 + e^{\text{logit}})$$

$$\text{Natural log (e)} = 2.7182$$

The expected rate is the number of patients predicted to experience an event based on the patient population characteristics. A hospital's expected event rate is the average probability of event for patients at the site. The hospital's observed event rate is the actual number of events divided by the total number of cases at the site. Dividing the observed rate by the expected rate yields the O/E ratio. The O/E ratio is a unitless measure which simplifies comparisons to the average, which is 1.

To calculate a hospital's risk-adjusted event rate (RAER), the O/E ratio is multiplied by the event rate in the entire population.

$$\text{RAER} = (\text{observed event rate} / \text{expected event rate}) * \text{SCOAP average event rate}$$

## Logistic Regression Models

The logistic regression models for mortality and operative re-intervention among colon/rectal procedures are presented in Tables 1 & 2, respectively. The logistic regression model for operative re-intervention among bariatric procedures is presented in Table 3. As yet, there is an insufficient number of deaths among the bariatric patients in the SCOAP database to successfully fit a regression model. The c-statistic (area under ROC curve) reflects a model's effectiveness in predicting an event. The c-statistic varies from 0.5 (the model's predictions are no better than chance) to 1.0 (the model always assigns higher probabilities to actual cases). A minimum of 0.6 to 0.65 is considered useful for risk-adjustment.

Table 1: Colon/Rectal Procedures: Post-op Mortality

Variable	Coef.	Std. Err.	P>z	[95% Conf. Interval]	
Elective	-1.31744	0.205796	0	-1.7208	-0.91409
Age	0.035637	0.010738	0.001	0.014591	0.056682
Low albumin	0.697454	0.150377	0	0.40272	0.992187
Home Oxygen Use	0.868204	0.235667	0	0.406305	1.330103
ASA: 3 or higher	1.250597	0.278603	0	0.704545	1.796648
Comorbidity Index: 3 or more	1.019674	0.245458	0	0.538585	1.500763
Cancer	-0.41398	0.137427	0.003	-0.68333	-0.14463
Perforation	0.630238	0.235761	0.008	0.168155	1.092321
Ischemia	1.297856	0.233196	0	0.8408	1.754911
Laparoscopic	-0.71836	0.235429	0.002	-1.17979	-0.25693
_cons	-6.15055				

C Statistic: 0.89

95% Confidence Interval: (0.881, 0.895)

Table 2: Colon/Rectal Procedures: Operative Re-intervention

Variable	Coef.	Std. Err.	P>z	[95% Conf. Interval]	
Age	-0.00484	0.003028	0.11	-0.01078	0.001093
Sex	0.528221	0.127182	0	0.278949	0.777492
Elective	-0.82043	0.130307	0	-1.07583	-0.56504
Low albumin	0.543817	0.126093	0	0.296679	0.790955
ASA: 3 or higher	0.503083	0.103883	0	0.299476	0.70669
_cons	-2.49088				

C Statistic: 0.68

95% Confidence Interval: (0.671, 0.691)

Table 3: Bariatric Procedures: Operative Re-intervention

Variable	Coef.	Std. Err.	P>z	[95% Conf. Interval]	
Age	0.008949	0.005495	0.103	-0.00182	0.019719
Sex	0.288051	0.106132	0.007	0.080037	0.496065
Low albumin	1.370308	0.613129	0.025	0.168596	2.572019
Bypass	1.681838	0.395778	0	0.906128	2.457548
BMI	0.021962	0.015724	0.162	-0.00886	0.05278
_cons	-6.74364				

C Statistic: 0.67

95% Confidence Interval: (0.657, 0.684)