2.2.5 Measure Calculation

The hospital-level all-cause RSCR is estimated using a hierarchical logistic regression model. In brief, the approach simultaneously models data at the patient and hospital levels to account for the variance in patient outcomes within and between hospitals. At the patient level, it models the log-odds of hospital admission with a complication within 90 days of the start of the index admission using age, sex, selected clinical covariates, and a hospital-specific effect. At the hospital level, the approach models the hospital-specific effects as arising from a normal distribution. The hospital effect represents the underlying risk of a complication at the hospital, after accounting for patient risk. The hospital-specific effects are given a distribution to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk, the hospital effects should be identical across all hospitals.

The RSCR is calculated as the ratio of the number of "predicted" admissions with a complication to the number of "expected" admissions with a complication at a given hospital, multiplied by the national observed complication rate, as illustrated in Figure 2.2.5.1.

Figure 2.2.5.1 — Equation for RSCR Calculation

$$\text{RSCR} = \frac{\text{Predicted Admissions with a Complication}}{\text{Expected Admissions with a Complication}} \times \text{National Observed Complication Rate}$$

For each hospital, the numerator of the ratio is the number of admissions with a complication within 90 days predicted based on the hospital's performance with its observed case mix; the denominator is the number of admissions with a complication expected based on the nation's performance with that hospital's case mix. This approach is analogous to a ratio of "observed" to "expected" used in other types of statistical analyses. It conceptually allows a particular hospital's performance, given its case mix, to be compared to an average hospital's performance with the same case mix. Thus, a lower ratio indicates lower-than-expected complication rates or better quality, while a higher ratio indicates higher-than-expected complication rates or worse quality.

The "predicted" number of admissions with a complication (the numerator) is calculated by using the coefficients estimated by regressing the risk factors and the hospital-specific effect on the risk of having an admission with a complication. The estimated hospital-specific effect is added to the sum of the estimated regression coefficients multiplied by the patient characteristics. The results are transformed using the inverse-link-function and summed over all patients attributed to a hospital to calculate a predicted value. The "expected" number of admissions with a complication (the denominator) is obtained in the same manner, except that a common effect using all hospitals in our sample is added in place of the hospital-specific effect. These results are also transformed using the inverse-link-function and summed over all patients attributed to a hospital to calculate an expected value. To assess hospital performance for each reporting period, we re-estimate the model coefficients using the data in each time period.

Multiplying the predicted over expected ratio by the national observed complication rate transforms the ratio into a rate that can be compared to the national observed complication rate.