

### Measure Score

Because the same admission may be attributed to more than one unique Eligible Clinician group, we could not apply the method used by the existing hospital-level HWR measure (CBE#1789) to construct risk standardized readmission rates. Instead, we adopted a method that, while requiring an assumption of independence across entities, allowed us to account for correlation within entity.

Let

- $Y_i$  be the observed (0, 1) outcome for patient  $i$ ;
- $\bar{Y}$  be the observed rate for all discharges in the reference population;
- $H$  be the total number of providers;
- $\hat{E}_i$  be the expected (predicted) patient level probability; and
- $n_h$  be the number of discharges at provider  $h$ .

We define the observed rate at provider  $h$  as

$$O_h = \frac{1}{n_h} \sum_{i=1}^{n_h} Y_i$$

The expected rate at provider  $h$  as

$$\hat{E}_h = \frac{1}{n_h} \sum_{i=1}^{n_h} \hat{E}_i$$

The Standardized Readmission Ratio (SRR) as

$$SRR_h = \frac{O_h}{\hat{E}_h}$$

Then the formula for the smoothed rate (SR) is

$$SR_h = (SRR_h \times \text{Shrinkage Weight}) + (1 - \text{Shrinkage Weight}) \quad (1)$$

Where

$$\begin{aligned} \text{Shrinkage Weight} &= \frac{\text{Signal Variance}}{\text{Signal Variance} + \text{Noise Variance}} \\ \text{Noise Variance } \hat{\sigma}_h^2 &= \left( \frac{1}{n_h \hat{E}_h} \right)^2 \sum_{i=1}^{n_h} \hat{E}_i (1 - \hat{E}_i) \\ \text{Signal Variance } \hat{\tau}^2 &= \frac{\sum_{h=1}^H \frac{1}{(\hat{\tau}^2 + \hat{\sigma}_h^2)^2} \max(0, \{(SRR_h - \overline{SRR})^2 - \hat{\sigma}_h^2\})}{\sum_{h=1}^H \frac{1}{(\hat{\tau}^2 + \hat{\sigma}_h^2)^2}} \quad (2) \end{aligned}$$

Note that  $\hat{\tau}^2$  appears on both sides of the signal variance equation and is solved by iteration.

For calculating the provider risk-adjusted readmission rate (RARR) using SR scores from 5 specialty cohorts, we combined the SRs using volume-weighted logarithmic mean as following:

$$\begin{aligned} SR_j &= \exp( (\sum m_{cj} \log(SR_{cj})) / \sum m_{cj} ) \\ RARR_j &= SRR_j * \bar{Y} \end{aligned} \quad (3)$$

where  $\bar{Y}$  = overall national observed readmission rate for all index admissions in all cohort,  $m_{cj}$  = the number of discharges for provider j in cohort c  $SR_{cj}$  = the calculated SR score for provider j in cohort c.

#### Creating Credible Interval Estimates

For purposes of estimating confidence intervals, we used bootstrapping. Because of overlapping assignment of patients, bootstrapping was at the specialty cohort level. Specifically, we select  $m=1, M$  random samples of discharges with replacement from each specialty cohort. Using the existing attribution, we calculated (1), (2), and (3) above for each provider. The 95 percent credible interval estimate of the  $RARR_j$  for each provider was used as the estimated 95 percent confidence interval.