# Thirty-Day All-Cause Unplanned Readmission Following Psychiatric Hospitalization in an Inpatient Psychiatric Facility (IPF Readmission)

## Evidence and Scientific Acceptability Attachment

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# Evidence Attachment

## Figure 1. Logic model for thirty-day all-cause unplanned readmission following psychiatric hospitalization in an inpatient psychiatric facility

**Measure Title:** (CBE ID 2860) Thirty-Day All-Cause Unplanned Readmission Following Psychiatric Hospitalization in an Inpatient Psychiatric Facility

**Measure Type:** Outcome

**Measure Description:** This is a facility-level outcome measure that estimates an unplanned, 30-day, risk-standardized readmission rate for adult Medicare fee for service (FFS) patient discharges from an inpatient psychiatric facility (IPF) with a principal discharge diagnosis of a psychiatric disorder or dementia/Alzheimer's disease. This measure reflects the quality of care provided to patients at IPFs by providing a reliable comparison between an individual IPF risk-standardized readmission rate and a national readmission rate. The reporting period used to identify cases in the measure population is 24 months. The reporting period begins on July 1 and ends on June 30 two years later. Data from July 1 through July 30 two years later are used to identify readmissions. CMS will calculate the measure using Part A and Part B claims data received by Medicare for payment purposes. Part A data are used to identify index admissions, readmissions, and some risk factors. Part B data are used to identify additional risk factors. This approach requires no additional data collection or reporting by IPFs.

| Inputs | Activities | Outputs | Outcomes | Impacts |
|---|---|---|---|---|
| • Submit Medicare Part A and Part B claims data.<br>• Incorporate literature findings and best practices that result in lower IPF readmission rates into care.<br>• Have current discharge preparation and discharge workflow and process.<br>• Educate clinicians and IPF staff about interventions to decrease readmission.<br>• Educate patients about condition and available community resources.<br>• Develop community behavioral health resources. | • IPFs implement best practices identified in literature.<br>• Revise, as needed, discharge preparation and discharge workflows and processes.<br>• Educate clinicians and IPF staff about interventions to decrease readmission.<br>• Connect with and develop relationships with community behavioral health resources.<br>• Deliver patient education about condition and community resources | • Revise discharge preparation and discharge processes and workflows.<br>• Educate patients using resources and materials available. | **Short Term:**<br>• Increased patient awareness of community behavioral health resources.<br>**Intermediate Term:**<br>• Increased patient engagement and utilization of community behavioral health resources.<br>**Long-term:**<br>• Increased availability of community behavioral health resources.<br>• Decrease in hospital and IPF readmission rates following discharge from an IPF. | • Reduction in IPF care costs associated with readmissions.<br>• Improvement in two-way communications and patient transitions between IPFs and community resources that bridge existing gaps.<br>• Improved patient engagement and satisfaction with behavioral care health system processes and outcomes. |

**Feedback Mechanisms**

- Measure performance scores, available on Care Compare at facility, state and national level.
- IPF Specific Report for 30-Day All-Cause Unplanned Readmission Following Psychiatric Hospitalization in an Inpatient Psychiatric Facility (IPF Readmission) Measure (READM-30-IPF)

**Assumptions**

- Communities into which IPFs discharge patients have outpatient resources to support and treat patients thus minimizing the likelihood of readmission.
- Patients have accessibility to outpatient resources.
- IPFs and community resources will work together to bridge the gap between IPF care and outpatient care during care transitions.

**External Factors**

- Community outpatient resource availability.
- Patient access and barriers to resources such as transportation, insurance, family support.

## Table 1. Performance scores by decile*

| | Overall | Min | Decile 1 | Decile 2 | Decile 3 | Decile 4 | Decile 5 | Decile 6 | Decile 7 | Decile 8 | Decile 9 | Decile 10 | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Performance Score | 19.3% | 13.2% | 15.2% | 16.7% | 17.5% | 18.2% | 18.7% | 19.4% | 20.0% | 20.8% | 21.9% | 24.5% | 31.3% |
| N of Entities | 1410 | 1 | 141 | 141 | 141 | 141 | 141 | 141 | 141 | 141 | 141 | 141 | 1 |
| N of Persons/Encounters/Episodes | 27,8203 | 242 | 28,012 | 25,662 | 26,312 | 25,219 | 25,812 | 27,229 | 28,154 | 28,235 | 28,205 | 35,363 | 334 |

* For IPF's meeting the >= 25 volume threshold using the FY 2025 risk adjusted claims data.

## Table 1a. Number of IPFs with performance worse, same and better compared to the national average for FY2019 through FY2025

| Performance period start date | Performance period end date | Fiscal year (FY) | National rate % | # IPFs worse than the national average | # IPFs same as the national average | # IPFs better than the national average | # IPF readmissions too few |
|---|---|---|---|---|---|---|---|
| 7/1/2015 | 6/30/2017 | 2019 | 20.1% | 177 | 1,325 | 109 | 81 |
| 7/1/2016 | 6/30/2018 | 2020 | 20.1% | 154 | 1,344 | 106 | 90 |
| 7/1/2017 | 6/30/2019 | 2021 | 20.1% | 158 | 1,352 | 98 | 92 |
| 7/1/2018 | 12/31/2019 | 2022 | 20.2% | 115 | 1,354 | 59 | 108 |
| 7/1/2019 | 6/30/2021 | 2023 | 20.1% | 94 | 1,345 | 44 | 134 |
| 7/1/2020 | 6/30/2022 | 2024 | 19.6% | 108 | 1,285 | 49 | 126 |
| 7/1/2021 | 6/30/2023 | 2025 | 19.4% | 99 | 1,265 | 46 | 137 |

Note: Lower rates indicate better performance. For FY 2022, the end of the performance period is shortened due to the COVID-19 pandemic.

## Data and Samples Attachment

### Table 3. Measured entities: Inpatient psychiatric facilities (IPFs) by type (free-standing vs. unit)

| Type | # IPFs | Percent |
|---|---|---|
| Free-standing | 590 | 38.1% |
| Unit | 957 | 61.9% |
| **Total** | **1,547** | **100.0%** |

### Table 4. Measured entities: Inpatient psychiatric facilities (IPFs) by volume

| Volume | # IPFs | Percent |
|---|---|---|
| < 25 eligible discharges | 137 | 8.9% |
| 25–500 eligible discharges | 1,338 | 86.5% |
| > 500 eligible discharges | 72 | 4.7% |
| **Total** | **1,547** | **100.0%** |

## Table 5. Patient characteristics of eligible discharges used in testing for the IPF Readmission measure

| Patient characteristics | Admission level | | Patient level | |
|---|---|---|---|---|
| | n | % | n | % |
| Total patient population | 279,579 | 100.00% | 179,831 | 100.0% |
| **Age** | | | | |
| 18 to 34 | 38,933 | 13.93% | 19,847 | 11.0% |
| 35 to 44 | 44,481 | 15.91% | 23,894 | 13.3% |
| 45 to 54 | 38,615 | 13.81% | 22,693 | 12.6% |
| 55 to 64 | 44,740 | 16.00% | 27,911 | 15.5% |
| 65 to 74 | 60,843 | 21.76% | 44,680 | 24.9% |
| 75 to 84 | 36,982 | 13.23% | 30,407 | 16.9% |
| 85+ | 14,985 | 5.36% | 13,179 | 7.3% |
| **Sex** | | | | |
| Female | 137,155 | 49.06% | 92,429 | 51.4% |
| Male | 142,423 | 50.94% | 87,401 | 48.6% |
| **Principal discharge diagnosis** | | | | |
| CCS 650 Adjustment disorders | 2,819 | 1.01% | N/A | N/A |
| CCS 651 Anxiety disorders | 3,930 | 1.41% | N/A | N/A |
| CCS 652/654/655 Attention-deficit, conduct, and disruptive behavior disorders/Developmental disorders/Disorders usually diagnosed in infancy, childhood, or adolescence | 942 | 0.34% | N/A | N/A |
| CCS 653 Delirium, dementia, and amnestic and other cognitive disorders | 32,319 | 11.56% | N/A | N/A |
| CCS 656 Impulse control disorders | 845 | 0.30% | N/A | N/A |
| CCS 657.1 Bipolar disorder | 50,008 | 17.89% | N/A | N/A |
| CCS 657.2/662 Depressive disorder | 62,603 | 22.39% | N/A | N/A |
| CCS 658 Personality disorders | 1,285 | 0.46% | N/A | N/A |
| CCS 659.1 Schizoaffective disorder | 58,820 | 21.04% | N/A | N/A |
| CCS 659.2 Psychosis | 50,734 | 18.15% | N/A | N/A |
| CCS 660 Alcohol-related disorders | 8,817 | 3.15% | N/A | N/A |

| Patient characteristics | Admission level | | Patient level | |
|---|---|---|---|---|
| | n | % | n | % |
| CCS 661 Substance-related disorders | 5,881 | 2.10% | N/A | N/A |
| CCS 670/663 Screening and history of mental health and substance abuse codes | 576 | 0.21% | N/A | N/A |

Note: Programming output does not produce patient-level data for principal discharge diagnosis, since this is a discharge-level variable.

# Reliability Attachment

## Full descriptions of reliability testing methods, including formulas

**Bootstrap reliability:**

We computed intra-class correlation (a measure of reliability) for each hospital using a PROC NLMIXED procedure in SAS. The intra-class correlation was calculated using the following formula:

$$ICC_h = \frac{\hat{\sigma}_b^2}{\hat{\sigma}_b^2 + \hat{\sigma}_e^2} \ ,$$

where $\hat{\sigma}_b^2$ is the between-hospital variance component which reflects the variability in the average measurements across different hospitals, $\hat{\sigma}_e^2$ is the error variance component which reflects the variability between samples *within* each hospital. Similar to signal-to-noise, the ICC quantifies the amount of variation in measure scores due to between-hospital differences rather than within.

We obtained estimates of the between-hospital and error variance components from a simple, intercept-only random effects model with no predictors. This random-effects model was fit to data made multilevel by creating 1,000 bootstrap samples, with replacement, of discharges among the hospitals meeting the minimum case threshold of at least 25 eligible discharges. By doing this, 1,000 risk-standardized readmission rates (RSRR's) per hospital were calculated. The random effects model can be expressed using the following equation and distributional assumptions:

$$Y_{ht} = \mu + \alpha_h + \varepsilon_{ht}$$

$$\alpha_h \sim N\left(0, \sigma_b^2\right); \varepsilon_{ht} \sim N\left(0, \frac{\sigma_e^2}{n_{ht}}\right)$$

where $Y_{ht}$ is the RSRR for hospital h for bootstrap sample t, $\mu$ is a fixed effect or intercept indicating the mean RSRR, $\alpha_h$ is a hospital-level random effect for hospital h, and $\varepsilon_{ht}$ is the residual bootstrap sample-level random effect for hospital h's bootstrap sample t.

With maximum likelihood estimates $\sigma_b^2$ and $\sigma_e^2$ obtained from the random effects model, we plugged these values into the formula above to compute an ICC per hospital. ICCs range from 0 to 1, where 0 indicates no agreement or reliability, and 1 indicates perfect agreement or reliability.

A high ICC indicates that the bootstrap samples provide similar measurements for each hospital, suggesting that the hospital-level metric is stable and reliable.

Table 2 provides the results of the bootstrap analysis. The mean ICC reliability was 0.66, ranging from 0.263 to 0.948.

### Table 2. Accountable entity-level reliability testing results*

| | Overall | Min | Decile 1 | Decile 2 | Decile 3 | Decile 4 | Decile 5 | Decile 6 | Decile 7 | Decile 8 | Decile 9 | Decile 10 | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reliability | 0.66 | 0.26 | 0.35 | 0.48 | 0.56 | 0.62 | 0.66 | 0.70 | 0.75 | 0.79 | 0.83 | 0.88 | 0.95 |
| Mean performance score | 19.3% | 18.1% | 18.8% | 19.1% | 19.0% | 19.2% | 19.3% | 19.1% | 19.2% | 19.7% | 19.8% | 19.7% | 17.7% |
| N of entities | 1410 | 4 | 140 | 141 | 141 | 143 | 140 | 142 | 140 | 141 | 141 | 141 | 1 |
| N of persons/episodes/ encounters | 278,203 | 100 | 5,471 | 9,093 | 12,810 | 16,448 | 19,462 | 23,547 | 28,836 | 36,327 | 47,590 | 78,619 | 1,277 |

* Reliability testing was conducted using regression adjusted scores.

# Validity Attachment

## Table 6a. Differences in the mean IPF Readmission rates by beneficiary subgroups*

| Category | Value | N | Observed rate | SD | Predicted rate | SD | Expected rate | SD |
|---|---|---|---|---|---|---|---|---|
| Sex | Male | 142,424 | 0.21 | 0.41 | 0.21 | 0.10 | 0.21 | 0.09 |
| | Female | 137,155 | 0.17 | 0.38 | 0.17 | 0.08 | 0.17 | 0.08 |
| Alcohol/Substance Use Disorder | Alcohol/SUD Disorder | 14,698 | 0.20 | 0.40 | 0.20 | 0.10 | 0.19 | 0.09 |
| | No Alcohol/SUD Disorder | 264,881 | 0.19 | 0.39 | 0.19 | 0.10 | 0.19 | 0.09 |
| Schizophrenia Disorder | Schizophrenia Diagnosis | 109,554 | 0.22 | 0.41 | 0.22 | 0.10 | 0.21 | 0.09 |
| | No Schizophrenia Diagnosis | 170,025 | 0.17 | 0.38 | 0.17 | 0.09 | 0.17 | 0.08 |
| Mood Disorder | Mood Disorder Diagnosis | 112,611 | 0.18 | 0.38 | 0.18 | 0.09 | 0.18 | 0.08 |
| | No Mood Disorder Diagnosis | 166,968 | 0.20 | 0.40 | 0.20 | 0.10 | 0.19 | 0.09 |
| Length of Stay | 1st Quartile (<6 days) | 72,796 | 0.20 | 0.40 | 0.20 | 0.11 | 0.19 | 0.09 |
| | 4th Quartile (>17 days) | 70,161 | 0.17 | 0.37 | 0.18 | 0.08 | 0.18 | 0.08 |

Note: Observed readmission rate is the percentage of IPF readmissions during the measurement period that were followed by an unplanned readmission to an IPF within 30 days. Predicted rate of readmissions is an estimated number of readmissions based on the IPF's performance and its observed case mix.

## Table 6b. Effect sizes for differences in group means by beneficiary characteristics

| Category | Patient group | Predicted rate (Cohen's d) | Expected rate (Cohen's d) | Observed rate (Cohen's d) |
|---|---|---|---|---|
| Sex | Male vs. female beneficiaries | 0.43 | 0.44 | 0.10 |
| Schizophrenia diagnosis | Beneficiaries with vs. without schizophrenia diagnosis | 0.46 | 0.47 | 0.11 |
| SUD diagnosis | Beneficiaries with vs. without SUD diagnosis | 0.09 | 0.09 | 0.02 |
| Mood Disorder diagnosis | Beneficiaries with vs. without Mood Disorder diagnosis | 0.20 | 0.21 | 0.05 |
| Length of stay at an IPF | 1st quartile (<6 days) vs. 4th quartile (>17 days) | 0.32 | 0.19 | 0.09 |

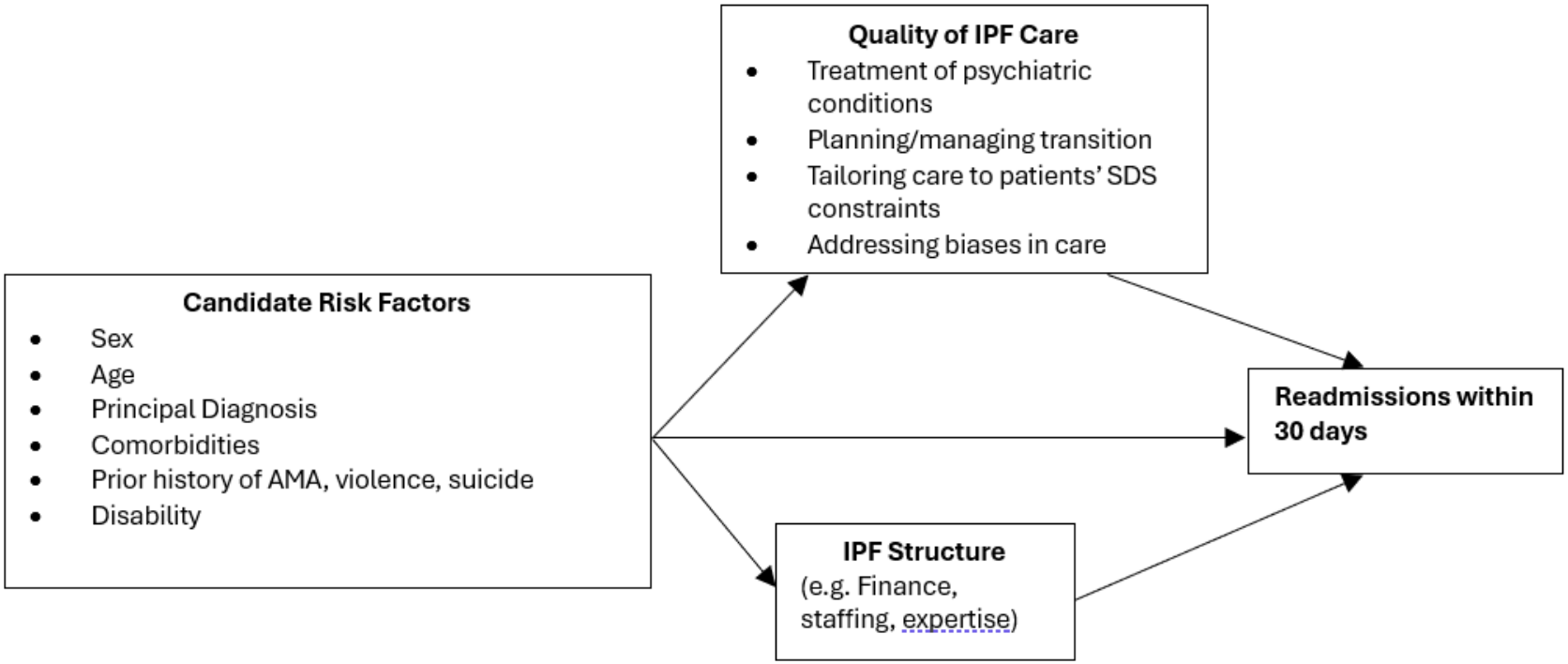
## Table 6c. Performance measure score correlation for IPF's meeting volume thresholds for each measure

| | IPF ED visits observed rate | IPF ED visits risk adjusted rate | 7-Day Follow-up After Psychiatric Hospitalization (FAPH) | 30-Day Follow-up After Psychiatric Hospitalization (FAPH) | Medication continuation |
|---|---|---|---|---|---|
| # IPF's | 1345 | 1345 | 912 | 912 | 767 |
| Pearson Correlation*** | 0.35 | 0.04 | -0.27 | -0.32 | -0.29 |
| Spearman Correlation*** | 0.35 | 0.05 | -0.28 | -0.33 | -0.27 |

* p < .05, ** p < .01, *** p < .001.

## Risk-Adjustment Attachment

**Figure 2. Conceptual model for patient risk factors that affect readmission following hospitalization**



## Table 7. Analysis of candidate risk factor frequencies using CCS categories

| Risk factor | Frequency | Percent | Observed readmission rate with risk factor | Observed readmission rate without risk factor | Selected into the final risk-adjustment model (Y/N) | % Bootstrap samples in which a risk-factor had a p-value <0.15 |
|---|---|---|---|---|---|---|
| **Sex** | | | | | **Y** | |
| Male | 142,424 | 50.94% | 0.21 | 0.17 | Y | 100.0% |
| Female | 137,155 | 49.06% | 0.17 | 0.21 | Y | 100.0% |
| **Age at admission** | | | | | **Y** | |
| 18 to 34 | 38,933 | 13.93% | 0.24 | 0.18 | Y | 100.0% |
| 35 to 44 | 44,481 | 15.91% | 0.23 | 0.18 | Y | 100.0% |
| 45 to 54 | 38,615 | 13.81% | 0.21 | 0.19 | Y | 100.0% |
| 55 to 64 | 44,740 | 16.00% | 0.20 | 0.19 | Y | 100.0% |
| 65 to 74 | 60,843 | 21.76% | 0.16 | 0.20 | Y | 100.0% |
| 75 to 84 | 36,982 | 13.23% | 0.14 | 0.20 | Y | 100.0% |
| 85+ | 14,985 | 5.36% | 0.13 | 0.19 | Y | 100.0% |
| **Principal discharge diagnosis** | | | | | **Y** | |
| CCS 650 Adjustment disorders | 2,819 | 1.01% | 0.15 | 0.19 | Y | 100.0% |
| CCS 651 Anxiety disorders | 3,930 | 1.41% | 0.17 | 0.19 | Y | 100.0% |
| CCS 652/654/655 Attention-deficit, conduct, and disruptive behavior disorders/Developmental disorders/Disorders usually diagnosed in infancy, childhood, or adolescence | 942 | 0.34% | 0.17 | 0.19 | Y | 100.0% |
| CCS 653 Delirium, dementia, and amnestic and other cognitive disorders | 32,319 | 11.56% | 0.15 | 0.20 | Y | 100.0% |
| CCS 656 Impulse control disorders | 845 | 0.30% | 0.17 | 0.19 | Y | 100.0% |
| CCS 657.1 Bipolar disorder | 50,008 | 17.89% | 0.20 | 0.19 | Y | 100.0% |
| CCS 657.2/662 Depressive disorder | 62,603 | 22.39% | 0.16 | 0.20 | Y | 100.0% |
| CCS 658 Personality disorders | 1,285 | 0.46% | 0.23 | 0.19 | Y | 100.0% |
| CCS 659.1 Schizo-affective disorder | 58,820 | 21.04% | 0.24 | 0.18 | Y | 100.0% |

| Risk factor | Frequency | Percent | Observed readmission rate with risk factor | Observed readmission rate without risk factor | Selected into the final risk-adjustment model (Y/N) | % Bootstrap samples in which a risk-factor had a p-value <0.15 |
|---|---|---|---|---|---|---|
| CCS 659.2 Psychosis | 50,734 | 18.15% | 0.19 | 0.19 | Y | 100.0% |
| CCS 660 Alcohol-related disorders | 8,817 | 3.15% | 0.20 | 0.19 | Y | 100.0% |
| CCS 661 Substance-related disorders | 5,881 | 2.10% | 0.20 | 0.19 | Y | 100.0% |
| CCS 670/663 Screening and history of mental health and substance abuse codes | 576 | 0.21% | 0.16 | 0.19 | Y | 100.0% |
| **Clinical comorbidities** | | | | | **Y** | |
| Other Infection (CC 1) | 57,944 | 20.73% | 0.24 | 0.18 | Y | 100.0% |
| Heart Failure (CC 10) | 24,141 | 8.63% | 0.22 | 0.19 | Y | 96.8% |
| Arrhythmia (CC 11) | 35,401 | 12.66% | 0.21 | 0.19 | Y | 78.2% |
| Asthma (CC 12) | 39,852 | 14.25% | 0.25 | 0.18 | Y | 99.5% |
| Dialysis (CC 13) | 794 | 0.28% | 0.27 | 0.19 | N | 29.8% |
| Endocrine Disease (CC 15) | 79,783 | 28.54% | 0.24 | 0.17 | Y | 100.0% |
| Anemia (CC 16) | 77,677 | 27.78% | 0.23 | 0.18 | Y | 100.0% |
| Pancreatic Disease (CC 20) | 1,587 | 0.57% | 0.29 | 0.19 | N | 12.5% |
| Urinary Tract Disorder (CC 21) | 14,765 | 5.28% | 0.22 | 0.19 | Y | 97.2% |
| Coagulation Defects (CC 22) | 13,325 | 4.77% | 0.24 | 0.19 | N | 26.9% |
| Peptic Ulcer (CC 23) | 14,182 | 5.07% | 0.26 | 0.19 | Y | 99.9% |
| Infection (CC 24) | 25,426 | 9.09% | 0.26 | 0.18 | N | 68.9% |
| Liver Disease (CC 25) | 23,238 | 8.31% | 0.27 | 0.18 | Y | 100.0% |
| Heart Disease (CC 26) | 71,192 | 25.46% | 0.21 | 0.19 | Y | 99.4% |
| COPD/Fibrosis (CC 28) | 47,498 | 16.99% | 0.22 | 0.18 | Y | 99.8% |
| Injury (CC 34) | 117,145 | 41.90% | 0.24 | 0.16 | Y | 100.0% |
| Diabetes Acute Complications (CC 4.1) | 983 | 0.35% | 0.26 | 0.19 | N | 14.8% |
| Diabetes Chronic Complications (CC 4.2) | 36,221 | 12.96% | 0.21 | 0.19 | N | 18.1% |
| Diabetes (CC 5) | 64,334 | 23.01% | 0.21 | 0.19 | Y | 100.0% |
| Hallucination (CC 50.1) | 15,349 | 5.49% | 0.28 | 0.19 | Y | 100.0% |

| Risk factor | Frequency | Percent | Observed readmission rate with risk factor | Observed readmission rate without risk factor | Selected into the final risk-adjustment model (Y/N) | % Bootstrap samples in which a risk-factor had a p-value <0.15 |
|---|---|---|---|---|---|---|
| Drug/Alcohol Psychosis (CC 54) | 11,961 | 4.28% | 0.31 | 0.19 | Y | 99.6% |
| Drug/Alcohol Dependence/Abuse (CC 55-56) | 118,488 | 42.38% | 0.24 | 0.16 | Y | 100.0% |
| Nicotine Dependence Disorder (CC 56.1) | 121,326 | 43.40% | 0.24 | 0.15 | Y | 100.0% |
| Schizophrenia/Psychosis (CC 57/58.3/59) | 132,468 | 47.38% | 0.24 | 0.15 | Y | 100.0% |
| Bipolar Disorder (CC 58.1) | 103,135 | 36.89% | 0.25 | 0.16 | Y | 100.0% |
| Depressive Disorder (CC 58.2/61) | 128,971 | 46.13% | 0.22 | 0.17 | Y | 100.0% |
| Antisocial Disorder (CC 60.1) | 4,502 | 1.61% | 0.36 | 0.19 | Y | 99.9% |
| Other Personality Disorders (CC 60.2) | 34,523 | 12.35% | 0.26 | 0.18 | Y | 100.0% |
| Anxiety (CC 62.1) | 172,846 | 61.82% | 0.21 | 0.16 | Y | 100.0% |
| PTSD (CC 62.2) | 50,965 | 18.23% | 0.24 | 0.18 | N | 56.3% |
| Other Psychiatric Disorders (CC 63) | 59,259 | 21.20% | 0.24 | 0.18 | Y | 99.7% |
| Intellectual Disability (CC 64-67) | 24,870 | 8.90% | 0.24 | 0.19 | N | 51.6% |
| Development Disorders (CC 68-69) | 27,071 | 9.68% | 0.25 | 0.18 | N | 17.9% |
| Hematological Disorder (CC 7) | 822 | 0.29% | 0.24 | 0.19 | Y | 75.7% |
| Seizures (CC 9) | 35,091 | 12.55% | 0.25 | 0.18 | Y | 100.0% |
| **History of being discharged against medical advice (AMA)** | | | | | **Y** | |
| Discharged AMA in prior 12 months | 10,536 | 3.77% | 0.36 | 0.18 | Y | 100.0% |
| Not discharged AMA in prior 12 months | 161,608 | 57.80% | 0.23 | 0.14 | Y | 100.0% |
| No discharges in prior 12 months | 107,435 | 38.43% | 0.11 | 0.24 | Y | 100.0% |
| History of suicidality (i.e. suicide attempt, suicidal ideation, intentional self-harm) | 155,465 | 55.61% | 0.22 | 0.15 | Y | 100.0% |
| Aggression | 47,302 | 16.92% | 0.27 | 0.18 | Y | 100.0% |

## Table 8. Risk adjustment factors and testing results

| Risk adjustment variable | Odds ratio | 95% CI | | P-value |
|---|---|---|---|---|
| Female (Reference category) | | | | |
| Male | 1.15 | 1.12 | 1.18 | <.0001 |
| 18 to 34 | 1.31 | 1.22 | 1.41 | <.0001 |
| 35 to 44 | 1.23 | 1.14 | 1.32 | <.0001 |
| 45 to 54 | 1.15 | 1.07 | 1.23 | 0.00 |
| 55 to 64 | 1.10 | 1.02 | 1.17 | 0.01 |
| 65 to 74 | 1.01 | 0.95 | 1.08 | 0.66 |
| 75 to 84 | 0.99 | 0.93 | 1.06 | 0.85 |
| 85+ (Reference category) | | | | |
| **Principal discharge diagnosis on index admission** | | | | |
| CCS 650 Adjustment disorders | 0.75 | 0.67 | 0.85 | <.0001 |
| CCS 651 Anxiety disorders | 0.92 | 0.83 | 1.01 | 0.08 |
| CCS 652/654/655 Attention-deficit, conduct, and disruptive behavior disorders/Developmental disorders/Disorders usually diagnosed in infancy, childhood, or adolescence | 0.81 | 0.67 | 0.98 | 0.03 |
| CCS 653 Delirium, dementia, and amnestic and other cognitive disorders | 1.10 | 1.04 | 1.15 | 0.00 |
| CCS 656 Impulse control disorders | 0.79 | 0.65 | 0.96 | 0.02 |
| CCS 657.1 Bipolar disorder | 0.94 | 0.90 | 0.97 | 0.00 |
| CCS 657.2/662 Depressive disorder | 0.87 | 0.83 | 0.90 | <.0001 |
| CCS 658 Personality disorders | 0.93 | 0.80 | 1.08 | 0.32 |
| CCS 659.1 Schizo-affective disorder (Reference category) | | | | |
| CCS 659.2 Psychosis | 0.93 | 0.90 | 0.96 | <.0001 |
| CCS 660 Alcohol-related disorders | 0.92 | 0.86 | 0.99 | 0.02 |
| CCS 661 Substance-related disorders | 0.83 | 0.77 | 0.89 | <.0001 |
| CCS 670/663 Screening and history of mental health and substance abuse codes | 0.82 | 0.64 | 1.05 | 0.12 |
| **Comorbidities** | | | | |
| **Psychiatric** | | | | |
| Hallucination (CC 50.1) | 1.19 | 1.14 | 1.24 | <.0001 |
| Drug/Alcohol Psychosis (CC 54) | 1.14 | 1.09 | 1.19 | <.0001 |

| Risk adjustment variable | Odds ratio | 95% CI | | P-value |
|---|---|---|---|---|
| Drug/Alcohol Dependence/Abuse (CC 55-56) | 1.09 | 1.06 | 1.12 | <.0001 |
| Schizophrenia/Psychosis (CC 57/58.3/59) | 1.17 | 1.14 | 1.20 | <.0001 |
| Bipolar Disorder (CC 58.1) | 1.21 | 1.18 | 1.24 | <.0001 |
| Depressive Disorder (CC 58.2/61) | 1.12 | 1.09 | 1.14 | <.0001 |
| Antisocial Disorder (CC 60.1) | 1.20 | 1.12 | 1.29 | <.0001 |
| Other Personality Disorders (60.2) | 1.13 | 1.10 | 1.17 | <.0001 |
| Anxiety (CC 62.1) | 1.05 | 1.03 | 1.08 | <.0001 |
| PTSD (CC 62.2)* | | | | |
| Other Psychiatric Disorders (CC 63) | 1.07 | 1.04 | 1.10 | <.0001 |
| Intellectual Disability (CC 64-67)* | | | | |
| Development Disorders (CC 68-69)* | | | | |
| **Non-psychiatric** | | | | |
| Other Infection (CC 1) | 1.07 | 1.04 | 1.10 | <.0001 |
| Heart Failure (CC 10) | 1.07 | 1.03 | 1.12 | 0.00 |
| Arrhythmia (CC 11) | 1.06 | 1.02 | 1.09 | 0.00 |
| Asthma (CC 12) | 1.07 | 1.04 | 1.10 | <.0001 |
| Dialysis (CC 13)* | | | | |
| Endocrine Disease (CC 15) | 1.09 | 1.06 | 1.12 | <.0001 |
| Anemia (CC 16) | 1.08 | 1.06 | 1.11 | <.0001 |
| Pancreatic Disease (CC 20)* | | | | |
| Urinary Tract Disorder (CC 21) | 1.03 | 0.99 | 1.08 | 0.16 |
| Coagulation Defects (CC 22)* | | | | |
| Peptic Ulcer (CC 23) | 1.08 | 1.04 | 1.13 | 0.00 |
| Infection (CC 24)* | | | | |
| Liver Disease (CC 25) | 1.13 | 1.09 | 1.17 | <.0001 |
| Heart Disease (CC 26) | 1.05 | 1.02 | 1.08 | 0.00 |
| COPD/Fibrosis (CC 28) | 1.04 | 1.01 | 1.07 | 0.01 |
| Injury (CC 34) | 1.12 | 1.10 | 1.15 | <.0001 |
| Diabetes Acute Complications (CC 4.1)* | | | | |

| Risk adjustment variable | Odds ratio | 95% CI | | P-value |
|---|---|---|---|---|
| Diabetes Chronic Complications (CC 4.2)* | | | | |
| Diabetes (CC 5) | 1.08 | 1.05 | 1.11 | <.0001 |
| Nicotine Dependence Disorder (CC 56.1) | 1.17 | 1.14 | 1.20 | <.0001 |
| Hematological Disorder (CC 7) | 1.00 | 0.84 | 1.20 | 0.97 |
| Seizures (CC 9) | 1.07 | 1.04 | 1.10 | <.0001 |
| **Patient claims history data** | | | | |
| Discharged AMA in prior 12 months | 1.90 | 1.80 | 2.01 | <.0001 |
| Not discharged AMA in prior 12 months | 1.43 | 1.39 | 1.47 | <.0001 |
| No discharges in prior 12 months (Reference category) | | | | |
| Suicide attempt/self-harm | 1.13 | 1.10 | 1.16 | <.0001 |
| Aggression | 1.12 | 1.09 | 1.15 | <.0001 |

* Variables not selected in the final model.

## Table 9a. Distribution of the observed and risk-adjusted score (by sex, age, and clinical risk-factors)

| Risk-adjustment model | N | Mean | min | p10 | p20 | p30 | p40 | p50 | p60 | p70 | p80 | p90 | max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No risk adjustment (observed rate) | 1,547 | 17.7% | 0.0% | 9.3% | 12.4% | 14.3% | 16.1% | 17.7% | 19.2% | 21.1% | 23.0% | 26.2% | 100.0% |
| Sex, age, and clinical risk factors | 1,547 | 19.2% | 13.2% | 16.3% | 17.2% | 17.9% | 18.5% | 19.0% | 19.5% | 20.2% | 21.1% | 22.4% | 31.3% |

## Table 9b. Results of the Hosmer-Lemeshow test for the risk-adjustment model

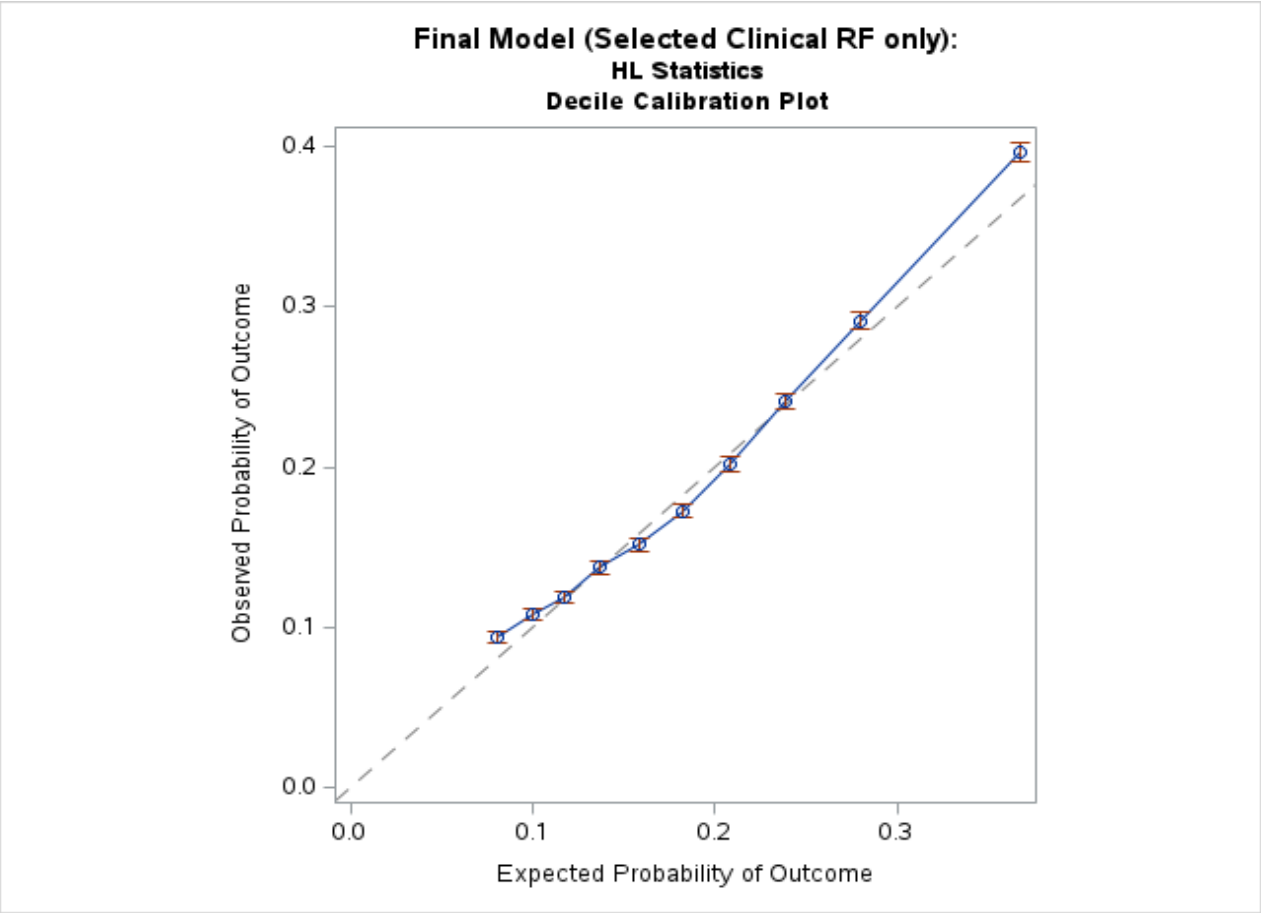
| Decile | Number of index admissions | Sum of expected IPF readmission rates* | Sum of observed IPF readmission rates* | Ratio of observed to expected IPF readmission rates* |
|---|---|---|---|---|
| 1 | 27,957 | 2,252 | 2,618 | 1.16 |
| 2 | 27,958 | 2,783 | 3,033 | 1.09 |
| 3 | 27,958 | 3,279 | 3,325 | 1.01 |
| 4 | 27,958 | 3,824 | 3,842 | 1.00 |
| 5 | 27,958 | 4,433 | 4,246 | 0.96 |
| 6 | 27,958 | 5,090 | 4,827 | 0.95 |
| 7 | 27,958 | 5,817 | 5,630 | 0.97 |
| 8 | 27,958 | 6,670 | 6,747 | 1.01 |
| 9 | 27,958 | 7,825 | 8,138 | 1.04 |
| 10 | 27,958 | 10,275 | 11,095 | 1.08 |

* Readmitted to IPF facility = Yes.

## Table 9c. Final model risk adjustment C-statistics

| IPF readmission rate | C-statistic |
|---|---|
| Observed vs. predicted | 0.673 |
| Observed vs. expected | 0.658 |

## Figure 3. Risk-decile calibration plot



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