Specifications for the Home Health Within-Stay Potentially Preventable Hospitalization Measure for the Home Health Quality Reporting Program

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CONTENTS

TABLES

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BACKGROUND

CMS has contracted with Abt Associates to develop the home health potentially preventable hospitalization measure. This measure development work was completed under the contracts named Outcome and Assessment Information Set (OASIS) Quality Measure Development and Maintenance Project (HHSM -500-2013-13001I, Task Order HHSM-500T0002) and Home Health and Hospice Quality Reporting Program Quality Measures and Assessment Instruments Development, Modification and Maintenance, & Quality Reporting Program Continued Contract (#75FCMC18D0014, Task Order # 75FCMC19F0001).

The reporting of quality data by home health agencies (HHAs) is mandated by Section 1895(b)(3)(B)(v)(II) of the Social Security Act ("the Act"). For more information on the statutory history of the HH Quality Reporting Program (QRP), please refer to https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HomeHealthQualityInits/Home-Health-Quality-Reporting-Requirements.html.

This document describes the specifications for the home health potentially preventable hospitalization measure.

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QUALITY MEASURE SPECIFICATIONS

1.1 Quality Measure Description

This measure reports a home health agency (HHA)-level rate of risk-adjusted potentially preventable hospitalization (PPH) or potentially preventable observation stays (PPOBS) that occur within a home health (HH) stay for all eligible stays at each agency. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least two days.

This measure calculates a risk-adjusted PPH rate for each HHA. This is derived by first calculating a standardized risk ratio – the predicted number of unplanned, potentially preventable hospital admissions or observation stays at the HHA divided by the expected number of admissions or observation stays for the same patients if treated at the average HHA. The standardized risk ratio is then multiplied by the mean potentially preventable admission or observation stay rate in the population (i.e., all Medicare fee-for-service (FFS) patients included in the measure) to generate the HHA-level standardized hospitalization rate of potentially preventable hospitalization.

1.2 Purpose/Rationale for the Quality Measure

Hospitalizations among the Medicare population are common, costly, and often preventable.[1,2,3] The Medicare Payment Advisory Commission (MedPAC) and a study by Jencks et al. estimated that 17-20 percent of Medicare beneficiaries discharged from the hospital were readmitted within 30 days. Among these hospital readmissions, MedPAC has estimated that 76 percent were considered potentially avoidable – associated with $12 billion in Medicare expenditures.[4,5] An analysis of data from a nationally representative sample of Medicare FFS beneficiaries receiving HH services in 2004 shows that HH patients receive significant amounts of acute and post-acute services after discharge from HH care.[6] Focusing on readmissions, Madigan and colleagues studied 74,580 Medicare HH patients and found that the 30-day rehospitalization rate was 26 percent, with the largest proportion related to a cardiac-related diagnosis (42 percent).[7] A study of dually eligible Medicare and Medicaid beneficiaries using data on hospitalizations from nursing home and home and community based services (HCBS)

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[1] Friedman, B. and J. Basu, The rate and cost of hospital readmissions for preventable conditions. Med Care Res Rev, 2004. 61(2): p. 225-40.
[2] Moy, E., Chang, E.,and Barret, M. Potentially Preventable Hospitalizations — United States, 2001–2009. MMWR, 2013, 62(03);139-143.
[3] Jencks, S.F., M.V. Williams, and E.A. Coleman, Rehospitalizations among Patients in the Medicare Fee-for-Service Program. New England Journal of Medicine, 2009. **360**(14): p. 1418-1428.
[4] *Ibid*.
[5] MedPAC, Payment policy for inpatient readmissions, in Report to the Congress: Promoting Greater Efficiency in Medicare. 2007: Washington D.C. p. 103-120.
[6] Wolff, J. L., Meadow, A., Weiss, C.O., Boyd, C.M., Leff, B. Medicare Home Health Patients' Transitions Through Acute And Post-Acute Care Settings." Medicare Care **11**(46) 2008; 1188-1193
[7] Madigan, E. A., N. H. Gordon, et al. Rehospitalization in a national population of home health care patients with heart failure." Health Serv Res 47(6): 2013; 2316-2338

waiver programs found that 39 percent of admissions were potentially avoidable[8]. Factors associated with hospitalizations from HH include functional disability, primary diagnoses of heart disease, and primary diagnosis of skin wounds.[9] Some other factors associated with hospitalization include time since most recent hospitalization[10] and chronic conditions such as chronic obstructive pulmonary disease and congestive heart failure.[11] These factors, including how HHAs address chronic conditions present before the HH stay, can determine whether patients can successfully avoid hospitalizations.[12] Patients admitted for an observation stay can often be treated in the same medical units and have similar medical needs as a patient admitted for inpatient care, but the service is billed as outpatient services and doesn't count as an index patient stay in the calculations of readmissions.[13] Understanding these factors can help HHAs design strategies to address avoidable hospitalizations. Few studies have investigated potentially preventable hospitalization rates from Home Health settings, especially hospitalizations that occur within the episode.

The Centers for Medicare & Medicaid Services (CMS) has addressed hospitalizations and readmissions with a number of home health measures. These include the *Acute Care Hospitalization* (Claims based) NQF # 0171; *Acute Care Hospitalization* (OASIS-based) (not NQF endorsed); *Rehospitalization During the First 30 Days of Home Health* (Claims-based) (will no longer NQF endorsed due to measure retirement/removal from HH QRP with the CY2023 HH QRP, per the CY2019 HH PPS final rule); *Emergency Department Use without Hospitalization* (Claims-based) NQF # 0173; *Emergency Department Use without Hospital Readmission During the First 30 Days of Home Health* (Claims-based) (will no longer NQF endorsed due to measure retirement/removal from HH QRP with the CY2023 HH QRP, per the CY2019 HH PPS final rule); and the IMPACT Act *Potentially Preventable 30-Day Post-Discharge Readmission Measure for Home Health* (not NQF endorsed).

1.3 Denominator

For the eligible HH stays at each HHA, the measure denominator is the risk-adjusted expected number of hospitalizations or observation stays. This estimate includes risk adjustment for patient characteristics with the HHA effect removed. The "expected" number of observation

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[8] Walsh, E. G., J. M. Wiener, et al. (2012). "Potentially avoidable hospitalizations of dually eligible Medicare and Medicaid beneficiaries from nursing facility and Home- and Community-Based Services waiver programs." J Am Geriatr Soc 60(5): 821-829.

[9] Lohman MC, Cotton, BP, Zagaria, AB, Bao, Y, Greenberg, RL, Fortuna, KL, Bruce, ML Hospitalization Risk and Potentially Inappropriate Medications among Medicare Home Health Nursing Patients,(2017) J Gen Intern Med. 32(12):1301-1308

[10] Hua M, Gong, MN, Brady J, Wunsch, H, Early and late unplanned rehospitalizations for survivors of critical illness(2015) Critical Care Medicine;43(2):430-438.

[11] Dye C, Willoughby D, Aybar-Damali B, Grady C, Oran R, Knudson A, Improving Chronic Disease Self-Management by Older Home Health Patients through Community Health Coaching (2018) Int J Environ Res Public Health. 15(4): 660.

[12] Lohman MC, Cotton, BP, Zagaria, AB, Bao, Y, Greenberg, RL, Fortuna, KL, Bruce, ML Hospitalization Risk and Potentially Inappropriate Medications among Medicare Home Health Nursing Patients,(2017) J Gen Intern Med. 32(12):1301-1308

[13] Sabbatini AK, Wright B. Excluding Observation Stays from Readmission Rates - What Quality Measures Are Missing, New England Journal of Medicine, 31;378(22):2062-2065.

stays or admissions is the projected number of risk-adjusted hospitalizations if the same patients were treated at the average HHA appropriate to the measure.

This population, like that of the numerator, is the group of Medicare FFS HH patients whose stays end during the observation window and who are not excluded for the reasons below.

Home Health Within-Stay Potentially Preventable Hospitalization Measure Exclusions: The following stays are excluded from the measure:

1) Stays where the patients are less than 18 years old.

Rationale: Patients under 18 years old are not included in the target population for this measure. Pediatric patients are relatively few and may have different patterns of care from adults.

2) Stays where the patients were not continuously enrolled in Part A FFS Medicare for the 12 months prior to the HH admission date through the end of the home health stay.

Rationale: The adjustment for certain comorbid conditions in the measure requires information on acute inpatient claims for one year prior to the HH admission, and hospitalizations and observation stays must be observable in the observation window following discharge. Patients without Part A coverage or who are enrolled in Medicare Advantage plans will not have complete claims in the system.

3) Stays that begin with a Low Utilization Payment Adjustment (LUPA) claim.

Rationale: Home health stays designated as LUPAs are excluded because it is unclear that the initial HHA had an opportunity to impact the patient's health outcomes.

4) Stays where the patient receives service from multiple agencies during the home health stay.

Rationale: These home health stays are excluded because it is unclear that the initial HHA had an opportunity to impact the patient's health outcomes.

5) Stays where the information required for risk adjustment is missing.

If one of the four conditions occur, the stays will be excluded:

- Missing beneficiary's birthday information;
- Beneficiary has gender other than male or female;
- Missing or invalid Health Insurance Prospective Payment System (HIPPS) code;

- Beneficiary has Medicare Status Code other than the following:
  - 10: Aged without ESRD
  - 11: Aged with ESRD
  - 20: Disabled without ESRD
  - 21: Disabled with ESRD
  - 31: ESRD only.

1.4 Numerator

Numerator Statement: Number of patients in the denominator with at least one potentially preventable hospitalization or observation stay during the HH stay.

1.4.1 Potentially Preventable Admissions or Observation Stays

The definition of potentially preventable hospitalization relies on the previously developed conceptual framework that for certain diagnoses, proper management and care of the condition by the home health agency, combined with appropriate, clearly explained, and implemented discharge instructions and referrals, can potentially prevent a patient's admission to the hospital. On the basis of this framework, the team followed the working conceptual definition for potentially preventable hospitalizations for home health created during the development of the *Potentially Preventable 30-Day Post-Discharge Readmission Measure for Home Health* measure. Although not specific to PAC or hospitalizations, the team used AHRQ PQIs/Ambulatory Care Sensitive Conditions (ACSCs) as a starting point for this work. The list of ACSCs consists of conditions for which hospitalization can potentially be prevented, given good outpatient care and early intervention.[14]

The team also performed analyses on Medicare claims data to identify the most frequent diagnoses associated with admissions among home health beneficiaries and then applied the conceptual PPH definition to evaluate whether these common conditions for a hospitalization may be considered potentially preventable. This list of conditions identified from the literature and claims analysis form the PPH definition. The full list of International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes that are used in the PPH definition is available for download on the HH QRP website.[15, 16]

In developing these sets of PPH conditions, we grouped them based on clinical rationale, as follows:

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[14] Agency for Healthcare Research and Quality: AHRQ Quality Indicators—Guide to Prevention Quality Indicators: Hospital Admission for Ambulatory Care Sensitive Conditions. AHRQ Pub. No. 02-R0203. Rockville, MD. Agency for Healthcare Research and Quality, 2001.

[15] https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HomeHealthQualityInits

[16] In limited instances, some ICD-10-CM code instances will only contribute to the PPH definition if additional secondary codes are also present on the claim associated with the inpatient admission. These secondary codes are indicated on the aforementioned list of ICD-10-CM codes comprising the PPH definition, as applicable.

1) Inadequate management of chronic conditions

2) Inadequate management of infections

3) Inadequate management of other unplanned events

4) Inadequate injury prevention

We sought technical expert and detailed clinical input on these definitions and overall approach. The Technical Expert Panel's (TEP) consensus was that it is feasible to apply the definitions for both admissions and observation stays. In instances where no clear consensus was reached among TEP members, we deferred to clinical expertise from the measure development team along with results from our environmental scan which suggested that these conditions were appropriate to consider as potentially preventable.

1.4.2 Planned Inpatient Admissions or Observation Stays

This measure is focused on inpatient admissions or observation stays that are potentially preventable (PP) and *unplanned*. Thus, planned admissions are not counted in the numerator—PP stays are only counted in the numerator if the inpatient admission or observation stay is considered unplanned. Planned inpatient admissions and observation stays are defined largely by the definition used for the *Hospital Wide Readmission*[17] and *Potentially Preventable Within Stay Readmission Measure for Inpatient Rehabilitation Facilities*[18] measures. The definition for classifying a planned inpatient admission or observation stay is described in greater detail below.

If an inpatient or outpatient claim contains a code for a procedure that is frequently a planned procedure, then that inpatient admission or observation stay is designated to be a planned inpatient admission or observation stay. Similarly, if an inpatient or outpatient claim contains a code for a diagnosis that is frequently a planned diagnosis, then that inpatient admission or observation stay is designated to be a planned inpatient admission or observation stay. However, the planned inpatient admission or observation stay is reclassified as unplanned if the claim also contains a code indicating one or more acute diagnoses from a specified list.

Other Documentation

AHRQ CCS groupings of ICD-10 codes: Documentation is available at: https://www.hcup-us.ahrq.gov/toolssoftware/ccs10/ccs10.jsp

[17] https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html

[18] https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/IRF-Quality-Reporting/IRF-Quality-Reporting-Program-Measures-Information-.html

CMS-HCC Mappings of ICD-10 Codes: Mappings are included in the software available at: http://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.html

Yale/CMS Planned Readmission Algorithm used for numerator exclusion criteria is available at: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology

The AHRQ Ambulatory Care Sensitive Conditions (ACSCs) are available at: https://www.ahrq.gov/research/findings/nhqrdr/chartbooks/carecoordination/measure3.html

More information on the Potentially Preventable Within Stay Readmission measure for Inpatient Rehabilitation Facilities is available at: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/IRF-Quality-Reporting/IRF-Quality-Reporting-Program-Measures-Information-.html

HCPCS General Information is available at: https://www.cms.gov/Medicare/Coding/MedHCPCSGenInfo/index.html

1.5 Data Sources

This measure relies on data from Medicare's Enrollment Database as well as FFS claims from the home health, inpatient, outpatient, and physician office settings. The enrollment files provide beneficiary-level information such as date of birth, date of death, sex, reasons for Medicare eligibility, and enrollment histories in Medicare Parts A and B. The FFS claims files provide information about each home health, hospital stay and observation stay, including dates of admission and discharge, diagnoses and procedures, and indicators for care received in the intensive care unit, coronary care unit, emergency department, skilled nursing facility, inpatient rehabilitation facility, and long-term care hospital. Furthermore, claims from all three file settings are used to construct for each patient a complete history of care before the home health stay, which is used for constructing risk adjustment variables. Below are links to documentation for each of the specific files for the HH measure.

- Information about the Medicare Enrollment Database is available online at: https://aspe.hhs.gov/centers-medicare-medicaid-services
- Documentation for the Medicare claims data is provided online by the Research Data Assistance Center (ResDAC). Data dictionaries for all standard analytical files (HH, Inpatient, Outpatient, and Carrier (physician office) RIFs) are available at: https://resdac.org/cms-data?tid_1%5B1%5D=1&tid%5B4931%5D=4931

1.6 Measure Window

The measure will be calculated using one calendar year of data. All HH stays having a discharge date within the observation window, except those that meet the exclusion criteria, will be included in the measure. The PPH observation window begins from the start of home health stay and spans to 1 day after discharge. Data from all home health stays with a discharge date from 1/1/2021 through 12/31/2021 was used for the HH PPH measure development.

1.7 Statistical Risk Model and Risk Adjustment Covariates

The following section summarizes the risk adjustment approach for the within-stay PPH measure.

A hierarchical regression method using a logistic regression to predict the probability of a countable (potentially preventable, unplanned) inpatient admission or observation stay is used. The risk adjusters are predictor variables. The patient characteristics related to each discharge and a marker for the specific discharging HHA are included in the equation. The equation is hierarchical in that both individual patient characteristics are accounted for as well as the clustering of patients into HHAs. The statistical model estimates both the average predictive effect of the patient characteristics across all providers and the degree to which each provider has an effect on inpatient admissions or observation stays that differs from that of the average provider. The provider effects are assumed to be randomly distributed around the average (according to a normal distribution). When computing the HHA effect, hierarchical modeling accounts for the known predictors of inpatient admissions or observation stays, on average, such as patient characteristics, the observed provider rate, and the number of provider stays eligible for the measure. The estimated provider effect is determined mostly by the provider's own data if the number of patient stays is relatively large (as the estimate would be relatively precise), but is adjusted towards the average if the number of patient stays is small (as that would yield an estimate of lower precision).

We used the following model:

Let Y_{ij} denote the outcome (equal to 1 if patient i is admitted during the HH stay, and equal to zero otherwise) for a patient i at HH provider j; Z_{ij} denotes a set of risk factors. We assume the outcome is related linearly to the covariates via a logit function with dispersion:

$$\text{logit}(P(Y_{ij} = 1 \mid Z_{ij}, \alpha_j)) = \log\left(\frac{P(Y_{ij} = 1 \mid Z_{ij}, \alpha_j)}{1-P(Y_{ij} = 1 \mid Z_{ij}, \alpha_j)}\right) = \alpha_j + \beta * Z_{ij} \quad (1)$$

$$\alpha_j = \mu + \omega_j;\ \omega_j \sim N(0, \tau^2) \quad (2)$$

where $Z_{ij} = (Z_1, Z_2, \ldots Z_k)$ is a set of k patient-level covariates; α_j represents the HH-specific intercept of the j-th HHA which is assumed to follow a normal distribution with mean μ and variance τ^2, independent of Z_{ij}; μ is the adjusted average outcome over all HHAs; and τ^2 is the between-HHA variance component.

The estimated equation is used twice in the measure. The sum of the probabilities of admission/observation stay of all patients in the measure, including both the effects of patient characteristics and the provider, is the "predicted number" of admissions/observation stays after adjusting for the provider's case mix. The same equation is used without the provider effect to compute the "expected number" of potentially preventable admissions/observation stays for the same patients at the average provider. The ratio of the predicted-to-expected number of admissions/observation stays is a measure of the degree to which the admissions/observation

stays are higher or lower than what would otherwise be expected. This standardized risk ratio is then multiplied by the mean admission/observation stay rate for all provider stays for the measure, yielding the risk-standardized admission/observation stay rate for each provider. This estimation procedure is recalculated for each measurement period. Estimating the equations for each measurement period allows the estimated effects of the patient characteristics to vary over time as medical treatment patterns change.

To account for beneficiary characteristics that may affect the risk of potentially preventable hospitalizations and observation stays, the risk adjustment model uses potential risk factors that fall into three categories:

1) Demographics;

2) Care received during a prior proximal hospitalization (if one occurred); and

3) Other care received within one year of the HH stay.

The following sub-sections detail risk factors in each of these categories in turn.

Factor 1: Demographics

Demographic risk factors included in the risk adjustment model are age and sex, enrollment status, and functional impairment scores.

Age and Sex: The risk adjustment model includes age and sex as covariates. Age-sex interactions allow the model to account for the differing effects of age on the outcomes for each sex. Age is subdivided into 12 bins for each sex: ages 18-34, 35-44, 45-54, five-year age bins from 55 to 94, and one bin for ages over 95. 65-69, Male is the reference group.

Enrollment Status: The model employs aged (reference), end stage renal disease (ESRD), and disability as covariates for the original reason for Medicare entitlement.

Functional Impairment Levels: The Home Health Patient-Driven Groupings Model (PDGM)[19] calculates a functional impairment score and level by summing the points assigned to responses from eight Outcome and Assessment Information Set (OASIS) fields. Within each of the 12 PDGM clinical groups, functional impairment scores are categorized into one of three functional impairment levels (low/medium/high) based on group-specific point thresholds. This impairment level, as represented within the coding of the five-character HIPPS code, is included in the risk adjustment model.

[19] More information on the HH PDGM software used in measure development, along with the current and prior versions of the software, are available at: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HomeHealthPPS/HH-PDGM.

Factor 2: Care Received during the Prior Proximal Hospitalization

Because beneficiaries who enter home health care from prior proximal hospitalizations[20] may have different health statuses, this model takes into account beneficiaries' immediate prior care setting, principal diagnoses, and procedures.

Length of Prior Proximal Hospitalization: The length of the prior proximal hospitalization is included in the model as a binary variable: 0-7 days (reference) and greater than or equal to 8 days.

Clinical Classification Software (CCS) during Prior Proximal Hospitalization: The risk model relies on CCS diagnosis and procedure groups to adjust for beneficiary health status during a prior proximal hospitalization, if a prior proximal hospitalization occurred. CCS diagnosis groups are defined using principal diagnosis codes from the prior proximal hospitalization. CCS procedure groups are defined using procedure codes recorded during the prior proximal hospitalization.

Factor 3: Other Care Received within One Year of Stay

To further account for beneficiaries who may have different health statuses entering into home health, this model adjusts for the beneficiaries' number of prior acute discharges, number of outpatient emergency department visits, number of skilled nursing facility visits, number of inpatient rehabilitation facility visits, number of long-term care hospital visits, and Hierarchical Condition Categories (HCC) comorbidities.

Number of Prior Acute Discharges: The model adjusts for the number of prior acute hospital discharges in the past year, excluding those that took place within 30 days prior to the start of home health or resumption of care. The number of prior acute discharges is classified in the model as 0 (i.e., no prior acute discharge; reference group), 1, 2, 3, 4, and 5 or more discharges.

Number of Outpatient Emergency Department Visits: The model also takes into account whether or not an outpatient emergency department (ED) visit took place within one year of the HH stay (i.e., 0 ED visits [reference] or 1 or more ED visits).

Number of Skilled Nursing Facility Visits: The model adjusts for whether or not a skilled nursing facility (SNF) visit took place within one year of the HH stay (i.e., 0 SNF visits [reference] or 1 or more SNF visits).

Number of Inpatient Rehabilitation Facility Visits: The model adjusts for whether or not an inpatient rehabilitation facility (IRF) visit took place within one year of the HH stay (i.e., 0 IRF visits [reference] or 1 or more IRF visits).

[20] Prior proximal hospitalizations for this measure are defined as inpatient stays within 30 days prior to home health admission.

Number of Long-Term Care Hospital Visits: The model adjusts for whether or not a long-term care hospital (LTCH) visit took place within one year of the HH stay (i.e., 0 LTCH visits [reference] or 1 or more LTCH visits).

Hierarchical Condition Categories (HCC) Comorbidities: To account for beneficiary health status within one year of the HH stay, the risk adjustment model also relies on the HCC framework.[21] The risk adjustment model includes hierarchically ranked HCCs based on the 2021 CMS-HCC risk adjustment model. HCC comorbidities are defined using secondary diagnoses from the prior proximal hospitalization (if a prior proximal hospitalization occurred) and all other diagnoses recorded in the inpatient, outpatient, and carrier settings during the year prior to the home health stay.

1.8 Measure Calculation Algorithm

The Medicare HH claims are matched to prior acute hospital stays, within-stay inpatient admissions/observation stays, and patient eligibility data to determine which stays remain in the measure (i.e., not excluded per the exclusions described above) and which have potentially preventable, unplanned inpatient admissions/observation stays.

The measures are calculated according to the following steps:

Step 1: Identify patients meeting the denominator (measure inclusion) criteria.

Step 2: Identify patients meeting the numerator (unplanned PPH/PPOBS) criteria.

Step 3: Identify presence or absence of risk adjustment variables for each patient.

Step 4: Calculate the predicted and expected number of inpatient admissions/observation stays for each provider using hierarchical logistic regression model.

The predicted number of inpatient admissions/observation stays for each HHA is calculated as the sum of the predicted probability of admission/observation stay for each patient included in the measure within HH stay, including the provider-specific effect. The expected number of inpatient admissions/observation stays for each HHA is calculated as the sum of the predicted probability of admission/observation stay for each patient included in the measure within HH stay, without the provider-specific effect. The model specific risk standardized admission/observation stay ratio for each HHA is calculated as follows.

To calculate the predicted number of admissions/observation stays $pred_j$ for index HH episodes at HHA_j, we used

[21] CMS-HCC Mappings of ICD-10 Codes: Mappings are included in the software at the following website: http://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.html

$$pred_j = \Sigma logit^{-1}(\mu + \omega_i + \beta * Z_{ij}) \quad (3)$$

where the sum is over all episodes in provider$_j$, and ω_i is the random intercept. To calculate the expected number exp$_j$ use

$$exp_j = \Sigma logit^{-1}(\mu + \beta * Z_{ij}) \quad (4)$$

Then, as a measure of excess or reduced admissions/observation stays among index stays at HHA$_j$, calculate the HH-wide standardized risk ratio, SRR$_j$, as

$$SRR_j = pred_j / exp_j \quad (5)$$

Step 5: Calculate the risk-standardized HH potentially preventable admission/observation stay rate.

The value obtained from equation (5) above, the SRR$_j$, is the HH-wide standardized risk ratio for HHA$_j$. To aid interpretation, the provider-wide standardized risk ratio, SRR$_j$, is then multiplied by the overall national raw admission/observation stay rate for all provider episodes, $\bar{Y}$, to produce the provider-wide risk-standardized hospitalization rate (RSHR$_j$).

$$RSHR_j = SRR_j * \bar{Y} \quad (6)$$

1.9 Measure Results

We present the preliminary risk adjustment model results for the HH PPH measure in **Table 1** in the **Appendix**.

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APPENDIX

Table 1: Logistic Regression Model Results for the Home Health Within-stay Potentially Preventable Hospitalization Measure (2021)

Number of stays included in the model = 2,944,280
Observed number (percentage) of stays that resulted in a potentially preventable hospitalization = 294,584 (10.01%)
Model c-statistic = 0.743

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
All Home Health Stays/Model Intercept	2,944,280	-	294,584	10.01%	Intercept: -3.489	0.031	Intercept: (-3.513, -3.464)	0
Demographics: Age & Sex								
Male, age 18-34 Years	5,081	0.17%	605	11.91%	0.158	1.171	(0.065, 0.25)	0.001
Male, age 35-44 Years	11,928	0.41%	1,609	13.49%	0.168	1.183	(0.109, 0.228)	0
Male, age 45-54 Years	27,729	0.94%	3,679	13.27%	0.075	1.078	(0.033, 0.117)	0
Male, age 55-59 Years	30,774	1.05%	4,059	13.19%	0.076	1.079	(0.036, 0.117)	0
Male, age 60-64 Years	47,019	1.60%	5,908	12.57%	0.024	1.024	(-0.011, 0.058)	0.184
Male, age 65-69 Years (Reference)	146,932	4.99%	14,140	9.62%	-	-	-	-
Male, age 70-74 Years	212,193	7.21%	20,245	9.54%	0.027	1.028	(0.003, 0.051)	0.025
Male, age 75-79 Years	210,123	7.14%	22,048	10.49%	0.101	1.106	(0.077, 0.125)	0
Male, age 80-84 Years	198,002	6.72%	21,920	11.07%	0.171	1.187	(0.147, 0.195)	0
Male, age 85-89 Years	161,687	5.49%	18,233	11.28%	0.243	1.275	(0.218, 0.268)	0
Male, age 90-94 Years	94,900	3.22%	10,597	11.17%	0.322	1.38	(0.293, 0.351)	0
Male, age 95+ Years	29,623	1.01%	3,321	11.21%	0.406	1.501	(0.363, 0.448)	0
Female, age 18-34 Years	4,256	0.14%	532	12.50%	0.086	1.09	(-0.013, 0.185)	0.089
Female, age 35-44 Years	11,918	0.40%	1,623	13.62%	0.194	1.214	(0.134, 0.253)	0
Female, age 45-54 Years	29,322	1.00%	3,634	12.39%	0.069	1.071	(0.027, 0.111)	0.001
Female, age 55-59 Years	33,413	1.13%	4,052	12.13%	0.063	1.065	(0.023, 0.103)	0.002
Female, age 60-64 Years	52,965	1.80%	6,385	12.06%	0.058	1.06	(0.024, 0.092)	0.001
Female, age 65-69 Years	178,852	6.07%	15,999	8.95%	0.026	1.026	(0.001, 0.051)	0.044
Female, age 70-74 Years	275,590	9.36%	24,603	8.93%	0.062	1.064	(0.039, 0.085)	0
Female, age 75-79 Years	296,030	10.05%	27,650	9.34%	0.113	1.119	(0.09, 0.135)	0
Female, age 80-84 Years	311,675	10.59%	29,429	9.44%	0.163	1.177	(0.14, 0.186)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Female, age 85-89 Years	287,576	9.77%	27,318	9.50%	0.213	1.237	(0.189, 0.236)	0
Female, age 90-94 Years	201,758	6.85%	18,979	9.41%	0.262	1.3	(0.237, 0.288)	0
Female, age 95+ Years	84,934	2.88%	8,016	9.44%	0.321	1.379	(0.29, 0.353)	0
Original Medicare Enrollment								
Original reason for entitlement was age (Reference)	2,289,035	77.75%	212,705	9.29%	-	-	-	-
Original reason for entitlement was disability	616,459	20.94%	73,845	11.98%	0.136	1.146	(0.124, 0.148)	0
Original reason for entitlement was ESRD	38,786	1.32%	8,034	20.71%	0.183	1.201	(0.15, 0.216)	0
Functional Impairment Score								
Medium Functional Score (Reference)	979,669	33.27%	82,784	8.45%	-	-	-	-
Low Functional Score	549,841	18.67%	38,862	7.07%	-0.164	0.849	(-0.178, -0.151)	0
High Functional Score	1,414,770	48.05%	172,938	12.22%	0.239	1.27	(0.229, 0.248)	0
Length of Prior Proximal Hospitalization								
0-7 Days: Prior Proximal Hospitalization (Reference)	2,536,011	86.13%	230,112	9.07%	-	-	-	-
≥ 8 Days: Prior Proximal Hospitalization	408,269	13.87%	64,472	15.79%	0.149	1.16	(0.137, 0.161)	0
Number of Prior Acute Discharges (Excluding Prior Proximal)								
0 Prior Acute Discharges (Reference)	1,746,740	59.33%	116,491	6.67%	-	-	-	-
1 Prior Acute Discharge	677,639	23.02%	74,861	11.05%	0.243	1.276	(0.233, 0.254)	0
2 Prior Acute Discharges	274,877	9.34%	43,147	15.70%	0.416	1.515	(0.402, 0.429)	0
3 Prior Acute Discharges	121,717	4.13%	24,651	20.25%	0.56	1.75	(0.542, 0.577)	0
4 Prior Acute Discharges	57,809	1.96%	14,085	24.36%	0.675	1.963	(0.652, 0.697)	0
5+ Prior Acute Discharges	65,498	2.22%	21,349	32.59%	0.922	2.514	(0.9, 0.944)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Number of Outpatient Emergency Department (ED) Visits								
0 Outpatient ED Visits (Reference)	1,544,206	52.45%	121,290	7.85%	-	-	-	-
≥ 1 Outpatient ED Visits	1,400,074	47.55%	173,294	12.38%	0.176	1.193	(0.168, 0.185)	0
Number of Skilled Nursing Facility (SNF) Visits								
0 SNF Visits (Reference)	2,246,066	76.29%	201,085	8.95%	-	-	-	-
≥ 1 SNF Visits	698,214	23.71%	93,499	13.39%	-0.003	0.997	(-0.013, 0.007)	0.574
Number of Inpatient Rehabilitation Facility (IRF) Visits								
0 IRF Visits (Reference)	2,664,513	90.50%	258,499	9.70%	-	-	-	-
≥ 1 IRF Visits	279,767	9.50%	36,085	12.90%	-0.055	0.947	(-0.068, -0.041)	0
Number of Long-term Care Hospital (LTCH) Visits								
0 LTCH Visits (Reference)	2,913,353	98.95%	287,591	9.87%	-	-	-	-
≥ 1 LTCH Visits	30,927	1.05%	6,993	22.61%	0.045	1.046	(0.014, 0.075)	0.004
CCS Diagnosis Groups								
No CCS Diagnosis due to No Prior Proximal Hospitalization (Reference)	1,590,777	54.03%	121,910	7.66%	-	-	-	-
Septicemia (except in labor) (CCS Diagnosis 2)	126,379	4.29%	21,276	16.84%	0.427	1.533	(0.409, 0.446)	0
Mycoses (CCS Diagnosis 4)	788	0.03%	138	17.51%	0.285	1.33	(0.093, 0.478)	0.004
Other and unspecified benign neoplasm (CCS Diagnosis 47)	3,639	0.12%	252	6.92%	-0.006	0.994	(-0.14, 0.127)	0.926
Diabetes mellitus with complications (CCS Diagnosis 50)	29,928	1.02%	5,514	18.42%	0.491	1.634	(0.456, 0.526)	0
Fluid and electroylte disorders (CCS Diagnosis 55)	18,994	0.65%	3,122	16.44%	0.472	1.604	(0.431, 0.513)	0
Deficiency and other anemia (CCS Diagnosis 59)	6,234	0.21%	1,059	16.99%	0.387	1.473	(0.317, 0.457)	0
Epilepsy, Convulsions (CCS Diagnosis 83)	7,804	0.27%	743	9.52%	-0.037	0.964	(-0.116, 0.042)	0.358

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Hypertension with complications and secondary hypertension (CCS Diagnosis 99)	95,515	3.24%	21,518	22.53%	0.588	1.8	(0.569, 0.606)	0
Acute myocardial infarction (CCS Diagnosis 100)	24,277	0.82%	3,217	13.25%	0.373	1.453	(0.333, 0.414)	0
Nonspecific Chest Pain (CCS Diagnosis 102)	2,641	0.09%	368	13.93%	0.212	1.236	(0.097, 0.326)	0
Cardiac dysrhythmias (CCS Diagnosis 106)	29,821	1.01%	4,659	15.62%	0.457	1.579	(0.422, 0.491)	0
Congestive Heart Failure (CCS Diagnosis 108)	5,973	0.20%	1,302	21.80%	0.609	1.839	(0.545, 0.674)	0
Acute Cerebrovascular Disease (CCS Diagnosis 109)	50,369	1.71%	3,752	7.45%	0.059	1.06	(0.021, 0.096)	0.002
Aortic, Peripheral, and Visceral Artery Aneurysms (CCS Diagnosis 115)	4,991	0.17%	436	8.74%	0.08	1.083	(-0.025, 0.185)	0.137
Other Circulatory Disease (CCS Diagnosis 117)	8,408	0.29%	1,117	13.28%	0.248	1.281	(0.182, 0.314)	0
Pneumonia (except that caused by Tuberculosis or Sexually Transmitted Disease) (CCS Diagnosis 122)	108,119	3.67%	12,308	11.38%	0.199	1.221	(0.176, 0.222)	0
Chronic obstructive pulmonary disease and bronchiectasis (CCS Diagnosis 127)	17,565	0.60%	4,121	23.46%	0.82	2.271	(0.782, 0.858)	0
Asthma (CCS Diagnosis 128)	1,081	0.04%	174	16.10%	0.53	1.699	(0.362, 0.699)	0
Aspiration pneumonitis; food/vomitus (CCS Diagnosis 129)	8,714	0.30%	1,717	19.70%	0.474	1.606	(0.417, 0.531)	0
Respiratory failure; insufficiency; arrest (adult) (CCS Diagnosis 131)	17,364	0.59%	3,934	22.66%	0.634	1.885	(0.595, 0.673)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Other lower respiratory disease (CCS Diagnosis 133)	3,984	0.14%	551	13.83%	0.301	1.351	(0.207, 0.395)	0
Intestinal infection (CCS Diagnosis 135)	5,989	0.20%	1,102	18.40%	0.556	1.743	(0.486, 0.625)	0
Abdominal Hernia (CCS Diagnosis 143)	7,389	0.25%	567	7.67%	-0.061	0.941	(-0.16, 0.038)	0.226
Diverticulosis and diverticulitis (CCS Diagnosis 146)	12,601	0.43%	1,265	10.04%	0.123	1.131	(0.062, 0.185)	0
Acute and unspecified renal failure (CCS Diagnosis 157)	31,724	1.08%	5,932	18.70%	0.463	1.589	(0.432, 0.494)	0
Urinary tract infections (CCS Diagnosis 159)	35,168	1.19%	5,476	15.57%	0.478	1.613	(0.447, 0.509)	0
Other diseases of kidney and ureters (CCS Diagnosis 161)	2,089	0.07%	336	16.08%	0.495	1.64	(0.372, 0.618)	0
Skin and subcutaneous tissue infections (CCS Diagnosis 197)	20,544	0.70%	3,463	16.86%	0.559	1.749	(0.519, 0.598)	0
Chronic Ulcer of Skin (CCS Diagnosis 199)	2,188	0.07%	581	26.55%	0.639	1.895	(0.536, 0.742)	0
Osteoarthritis (CCS Diagnosis 203)	63,627	2.16%	1,181	1.86%	-0.486	0.615	(-0.567, -0.404)	0
Spondylosis, Intervertebral Disc Disorders, Other Back Problems (CCS Diagnosis 205)	34,747	1.18%	1,555	4.48%	-0.078	0.925	(-0.142, -0.014)	0.017
Fracture of upper limb (CCS Diagnosis 229)	8,987	0.31%	506	5.63%	-0.152	0.859	(-0.254, -0.051)	0.003
Fracture of lower limb (CCS Diagnosis 230)	16,046	0.54%	937	5.84%	0.096	1.101	(0.012, 0.181)	0.026
Other fractures (CCS Diagnosis 231)	26,521	0.90%	1,941	7.32%	-0.035	0.966	(-0.084, 0.014)	0.159
Complications of surgical procedures or medical care (CCS Diagnosis 238)	27,818	0.94%	3,722	13.38%	0.16	1.173	(0.122, 0.198)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Rehabilitation care; fitting of prostheses; and adjustment of devices (CCS Diagnosis 254)	26	0.00%	>20	(redacted)	0.371	1.449	(-0.945, 1.686)	0.581
Mood Disorders (CCS Diagnosis 657)	4,245	0.14%	365	8.60%	-0.294	0.745	(-0.405, -0.183)	0
Schizophrenia and Other Psychotic Disorders (CCS Diagnosis 659)	2,365	0.08%	194	8.20%	-0.361	0.697	(-0.514, -0.209)	0
Miscellaneous Disorders (CCS Diagnosis 670)	478,841	16.26%	52,270	10.92%	0.215	1.24	(0.202, 0.229)	0
CCS Procedure Groups								
Incision and excision of CNS (CCS Procedural 1)	6,074	0.21%	498	8.20%	-0.023	0.977	(-0.122, 0.076)	0.647
Insertion; replacement; or removal of extracranial ventricular shunt (CCS Procedural 2)	1,586	0.05%	95	5.99%	-0.417	0.659	(-0.629, -0.205)	0
Laminectomy; excision intervertebral disc (CCS Procedural 3)	18,082	0.61%	595	3.29%	-0.245	0.783	(-0.35, -0.14)	0
Diagnostic spinal tap (CCS Procedural 4)	7,886	0.27%	861	10.92%	-0.176	0.838	(-0.251, -0.102)	0
Other OR therapeutic nervous system procedures (CCS Procedural 9)	19,134	0.65%	964	5.04%	-0.136	0.873	(-0.208, -0.063)	0
Lobectomy or pneumonectomy (CCS Procedural 36)	4,264	0.14%	271	6.36%	-0.51	0.601	(-0.637, -0.382)	0
Other OR therapeutic procedures on respiratory system (CCS Procedural 42)	6,656	0.23%	746	11.21%	-0.088	0.915	(-0.17, -0.007)	0.033
Coronary artery bypass graft (CABG) (CCS Procedural 44)	26,524	0.90%	1,931	7.28%	-0.274	0.76	(-0.348, -0.201)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator (CCS Procedural 48)	19,813	0.67%	2,327	11.74%	-0.282	0.754	(-0.329, -0.235)	0
Extracorporeal circulation auxiliary to open heart procedures (CCS Procedural 50)	35,160	1.19%	2,854	8.12%	-0.137	0.872	(-0.195, -0.079)	0
Endarterectomy; vessel of head and neck (CCS Procedural 51)	4,963	0.17%	384	7.74%	-0.12	0.887	(-0.228, -0.011)	0.031
Peripheral vascular bypass (CCS Procedural 55)	6,442	0.22%	872	13.54%	-0.079	0.924	(-0.156, -0.001)	0.047
Creation; revision and removal of arteriovenous fistula or vessel-to-vessel cannula for dialysis (CCS Procedural 57)	0	0.00%	0	0.00%	0	1	(0, 0)	0
Other OR procedures on vessels other than head and neck (CCS Procedural 61)	56,288	1.91%	6,418	11.40%	0.025	1.025	(-0.011, 0.061)	0.168
Bone marrow biopsy (CCS Procedural 65)	4,490	0.15%	866	19.29%	0.206	1.228	(0.125, 0.286)	0
Colostomy; temporary and permanent (CCS Procedural 72)	7,970	0.27%	884	11.09%	0	1	(-0.079, 0.078)	0.993
Small bowel resection (CCS Procedural 75)	1,634	0.06%	200	12.24%	0.154	1.167	(-0.003, 0.311)	0.054
Colorectal resection (CCS Procedural 78)	13,685	0.46%	1,410	10.30%	0.035	1.036	(-0.028, 0.098)	0.277
Appendectomy (CCS Procedural 80)	3,054	0.10%	247	8.09%	-0.222	0.801	(-0.357, -0.086)	0.001
Cholecystectomy and common duct exploration (CCS Procedural 84)	10,023	0.34%	896	8.94%	-0.296	0.744	(-0.369, -0.223)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Other hernia repair (CCS Procedural 86)	4,715	0.16%	412	8.74%	-0.048	0.953	(-0.165, 0.069)	0.419
Excision; lysis peritoneal adhesions (CCS Procedural 90)	13,852	0.47%	1,456	10.51%	-0.06	0.942	(-0.122, 0.003)	0.061
Peritoneal dialysis (CCS Procedural 91)	3,373	0.11%	774	22.95%	0.206	1.229	(0.12, 0.293)	0
Other OR upper GI therapeutic procedures (CCS Procedural 94)	6,029	0.20%	680	11.28%	0.021	1.021	(-0.064, 0.106)	0.632
Other OR lower GI therapeutic procedures (CCS Procedural 96)	17,377	0.59%	1,838	10.58%	-0.077	0.926	(-0.133, -0.021)	0.007
Other non-OR gastrointestinal therapeutic procedures (CCS Procedural 98)	25,456	0.86%	3,637	14.29%	0.019	1.019	(-0.019, 0.057)	0.334
Other OR gastrointestinal therapeutic procedures (CCS Procedural 99)	17,782	0.60%	2,017	11.34%	-0.037	0.963	(-0.091, 0.016)	0.174
Nephrotomy and nephrostomy (CCS Procedural 103)	512	0.02%	89	17.38%	-0.099	0.906	(-0.342, 0.144)	0.425
Kidney transplant (CCS Procedural 105)	2,233	0.08%	322	14.42%	-0.007	0.993	(-0.133, 0.119)	0.909
Other diagnostic procedures of urinary tract (CCS Procedural 110)	2,107	0.07%	423	20.08%	0.249	1.283	(0.136, 0.362)	0
Other non-OR therapeutic procedures of urinary tract (CCS Procedural 111)	11,317	0.38%	2,497	22.06%	0.262	1.299	(0.213, 0.311)	0
Hysterectomy; abdominal and vaginal (CCS Procedural 124)	2,251	0.08%	220	9.77%	0.135	1.145	(-0.011, 0.281)	0.07
Partial excision bone (CCS Procedural 142)	13,674	0.46%	1,683	12.31%	0.032	1.033	(-0.026, 0.09)	0.275

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Treatment; fracture or dislocation of radius and ulna (CCS Procedural 145)	3,383	0.11%	176	5.20%	-0.185	0.831	(-0.351, -0.02)	0.028
Treatment; fracture or dislocation of hip and femur (CCS Procedural 146)	41,810	1.42%	2,407	5.76%	-0.275	0.759	(-0.323, -0.228)	0
Treatment; fracture or dislocation of lower extremity (other than hip or femur) (CCS Procedural 147)	10,541	0.36%	552	5.24%	-0.446	0.64	(-0.554, -0.338)	0
Other fracture and dislocation procedure (CCS Procedural 148)	14,676	0.50%	913	6.22%	-0.13	0.878	(-0.202, -0.057)	0
Arthroplasty knee (CCS Procedural 152)	45,077	1.53%	983	2.18%	-0.579	0.56	(-0.668, -0.491)	0
Hip replacement; total and partial (CCS Procedural 153)	53,673	1.82%	1,925	3.59%	-0.462	0.63	(-0.516, -0.408)	0
Arthroplasty other than hip or knee (CCS Procedural 154)	7,425	0.25%	224	3.02%	-0.597	0.551	(-0.737, -0.456)	0
Amputation of lower extremity (CCS Procedural 157)	15,070	0.51%	2,659	17.64%	-0.128	0.88	(-0.177, -0.078)	0
Spinal fusion (CCS Procedural 158)	33,568	1.14%	1,285	3.83%	-0.328	0.721	(-0.408, -0.247)	0
Other therapeutic procedures on muscles and tendons (CCS Procedural 160)	15,794	0.54%	1,794	11.36%	-0.03	0.97	(-0.085, 0.025)	0.279
Other OR therapeutic procedures on joints (CCS Procedural 162)	25,809	0.88%	1,321	5.12%	-0.282	0.754	(-0.347, -0.216)	0
Incision and drainage; skin and subcutaneous tissue (CCS Procedural 168)	8,856	0.30%	1,192	13.46%	-0.086	0.918	(-0.151, -0.021)	0.01
Skin graft (CCS Procedural 172)	4,934	0.17%	643	13.03%	-0.105	0.9	(-0.196, -0.015)	0.022

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
Organ transplantation (other than bone marrow, corneal or kidney) (CCS Procedural 176)	1,154	0.04%	159	13.78%	-0.213	0.808	(-0.39, -0.036)	0.018
Diagnostic ultrasound of heart (echocardiogram) (CCS Procedural 193)	56,115	1.91%	7,377	13.15%	-0.007	0.993	(-0.034, 0.021)	0.635
Magnetic resonance imaging (CCS Procedural 198)	3,748	0.13%	380	10.14%	-0.039	0.961	(-0.151, 0.073)	0.491
Radiation therapy (CCS Procedural 211)	1,358	0.05%	276	20.32%	0.396	1.485	(0.256, 0.535)	0
Traction; splints; and other wound care (CCS Procedural 214)	6,107	0.21%	655	10.73%	0.027	1.027	(-0.06, 0.113)	0.544
Cancer chemotherapy (CCS Procedural 224)	4,636	0.16%	857	18.49%	0.168	1.183	(0.087, 0.248)	0
Other therapeutic procedures (CCS Procedural 231)	139,507	4.74%	14,516	10.41%	-0.135	0.874	(-0.155, -0.114)	0
HCC Comorbidity								
HCC8: Metastatic Cancer and Acute Leukemia	131,316	4.46%	20,379	15.52%	0.397	1.488	(0.38, 0.415)	0
HCC9: Lung and Other Severe Cancers	84,565	2.87%	12,337	14.59%	0.23	1.258	(0.209, 0.251)	0
HCC10: Lymphoma and Other Cancers	74,922	2.54%	8,711	11.63%	0.129	1.138	(0.105, 0.153)	0
HCC18: Diabetes with Chronic Complications	925,224	31.42%	125,001	13.51%	0.163	1.176	(0.153, 0.172)	0
HCC19: Diabetes without Complication	210,509	7.15%	17,985	8.54%	0.027	1.027	(0.01, 0.044)	0.002
HCC21: Protein-Calorie Malnutrition	280,758	9.54%	48,366	17.23%	0.095	1.1	(0.083, 0.107)	0
HCC28: Cirrhosis of Liver	41,919	1.42%	6,750	16.10%	0.114	1.12	(0.085, 0.142)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
HCC33: Intestinal Obstruction/Perforation	159,900	5.43%	23,433	14.65%	-0.058	0.943	(-0.075, -0.042)	0
HCC39: Bone/Joint/Muscle Infections/Necrosis	135,133	4.59%	22,357	16.54%	0.061	1.063	(0.043, 0.08)	0
HCC46: Severe Hematological Disorders	38,345	1.30%	6,569	17.13%	0.122	1.13	(0.093, 0.152)	0
HCC47: Disorders of Immunity	160,667	5.46%	25,906	16.12%	0.043	1.044	(0.027, 0.059)	0
HCC54: Drug/Alcohol Psychosis	12,440	0.42%	1,452	11.67%	-0.192	0.825	(-0.25, -0.134)	0
HCC55: Drug/Alcohol Dependence	151,342	5.14%	19,691	13.01%	0.004	1.004	(-0.013, 0.021)	0.621
HCC78: Parkinson's and Huntington's Diseases	148,317	5.04%	14,871	10.03%	0.075	1.078	(0.057, 0.094)	0
HCC80: Coma, Brain Compression/Anoxic Damage	40,567	1.38%	5,653	13.93%	0.009	1.009	(-0.023, 0.041)	0.569
HCC84: Cardio-Respiratory Failure and Shock	583,334	19.81%	100,688	17.26%	0.125	1.133	(0.114, 0.135)	0
HCC85: Congestive Heart Failure	1,078,592	36.63%	167,736	15.55%	0.317	1.373	(0.308, 0.327)	0
HCC88: Acute Myocardial Infarction	156,659	5.32%	18,308	11.69%	-0.014	0.986	(-0.031, 0.003)	0.099
HCC96: Specified Heart Arrhythmias	1,029,257	34.96%	143,063	13.90%	0.174	1.191	(0.165, 0.183)	0
HCC99: Cerebral Hemorrhage	66,369	2.25%	7,431	11.20%	-0.074	0.929	(-0.104, -0.044)	0
HCC100: Ischemic or Unspecified Stroke	297,406	10.10%	34,728	11.68%	-0.045	0.956	(-0.06, -0.031)	0
HCC103: Hemiplegia/Hemiparesis	177,859	6.04%	21,073	11.85%	0.003	1.003	(-0.015, 0.021)	0.759
HCC108: Vascular Disease	911,315	30.95%	104,836	11.50%	0.009	1.009	(0, 0.018)	0.039
HCC111: Chronic Obstructive Pulmonary Disease	760,037	25.81%	112,766	14.84%	0.228	1.256	(0.218, 0.237)	0
HCC114: Aspiration and specified bacterial pneumonias	120,853	4.10%	24,233	20.05%	0.09	1.094	(0.073, 0.107)	0

Covariate	Stay Count	% Stays	PPH Count	PPH Rate	Estimate	Odds Ratio	95% CI	P-value
HCC122: Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	49,400	1.68%	8,160	16.52%	0.093	1.097	(0.066, 0.119)	0
HCC134: Dialysis Status	105,511	3.58%	22,551	21.37%	0.285	1.329	(0.263, 0.306)	0
HCC135: Acute Renal Failure	730,723	24.82%	119,760	16.39%	0.295	1.343	(0.285, 0.305)	0
HCC157: Pressure Ulcer of Skin with Necrosis Through to Muscle, Tendon, or Bone	106,645	3.62%	23,596	22.13%	0.487	1.628	(0.47, 0.504)	0
HCC161: Chronic Ulcer of Skin, Except Pressure	213,411	7.25%	32,414	15.19%	0.335	1.398	(0.321, 0.349)	0
HCC167: Major Head Injury	75,804	2.57%	7,952	10.49%	-0.093	0.911	(-0.12, -0.065)	0
HCC170: Hip Fracture/Dislocation	205,133	6.97%	17,942	8.75%	-0.181	0.835	(-0.2, -0.162)	0
HCC173: Traumatic Amputations and Complications	32,119	1.09%	4,795	14.93%	-0.094	0.911	(-0.127, -0.06)	0
HCC176: Complications of Specified Implant Device of Graft	218,560	7.42%	36,155	16.54%	0.097	1.102	(0.083, 0.112)	0
HCC188: Artificial Openings for Feeding or Elimination	109,773	3.73%	20,724	18.88%	0.255	1.291	(0.237, 0.273)	0
HCC189: Amputation Status, Lower Limb/Amputation Complications	40,262	1.37%	7,121	17.69%	0.091	1.095	(0.062, 0.119)	0

Notes: CCS diagnosis groups are defined using principal diagnosis codes from the prior proximal hospitalization. Logistic regression model includes the random effects of 9,334 home health agencies represented in the patient population. CCS procedure groups are defined using procedure codes recorded during the prior proximal hospitalization.