Evaluation of the Home Health Value-Based Purchasing (HHVBP) Model

Fourth Annual Report
Technical Appendices

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NOTICE
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Acronym List

Acronym	Term
ACH	Acute Care Hospitalization
ACO	Accountable Care Organization
ADL	Activities of Daily Living
AHRQ	Agency for Healthcare Research and Quality
AHRF	Area Health Resource File
AKI	Acute Kidney Injury
APM	Alternative Payment Model
AT	Achievement Threshold
BETOS	Berenson-Eggers Type of Service
BM	Benchmark
BPCI	Bundled Payment for Care Improvement
CBSA	Core-Based Statistical Area
CCI	Charlson Comorbidity Index
CCN	CMS Certification Number
CCS	Clinical Classifications Software
CCW	Chronic Conditions Data Warehouse
CI	Confidence Interval
CJR	Comprehensive Care for Joint Replacement
CME	Common Medicare Environment
CMMI	Center for Medicare & Medicaid Innovation
CMS	Centers for Medicare and Medicaid Services
CY	Calendar Year
D-in-D	Difference-in-Differences
DME	Durable Medical Equipment
ED	Emergency Department
ESRD	End-Stage Renal Disease
FFS	Fee-for-Service
FIPS	Federal Information Processing Standards
HCC	Hierarchical Condition Category
HCPCS	Healthcare Common Procedure Coding System
HH	Home Health
HHA	Home Health Agency
HHC	Home Health Compare
HHCAHPS	Home Health Consumer Assessment of Healthcare Providers and Systems
HHVBP	Home Health Value-Based Purchasing
HMO	Health Maintenance Organization
HUD	U.S. Department of Housing and Urban Development
ICD	International Classification of Diseases
IDR	Integrated Data Repository
iQIES	internet Quality Improvement and Evaluation System
LUPA	Low Utilization Payment Adjustment
MBSF	Master Beneficiary Summary File
MDD	Master Data Demonstration
MDM	Master Data Management
MDS	Minimum Data Set
MedPAR	Medicare Provider Analysis and Review
MS-DRG	Medicare Severity Diagnosis Related
MSSP	Medicare Shared Savings Program

Acronym	Term
NIH	National Institutes of Health
OASIS	Outcome and Assessment Information Set
OCM	Oncology Care Model
PAC	Post-acute Care Provider
PECOS	Provider Enrollment, Chain and Ownership System
PEP	Partial Episode Payment
POS	Provider of Services
QI	Quality Improvement
QIES	Quality Improvement and Evaluation System
RIF	Research Identifiable File
ROC	Resumption of Care
SNF	Skilled Nursing Facility
SOC	Start of Care
TA	Technical Assistance
TNC	Total Normalized Composite
TEP	Technical Expert Panel
TPS	Total Performance Score
UAF	Unified Analytic File
VRDC	Virtual Research Data Center

Appendix A:
Quantitative Technical Appendix

This Technical Appendix provides details about the data sources and methods used to conduct the quantitative analyses for this Annual Report. Each of the following topics is covered below:

1. Detailed discussion of our quantitative analytic approach, including a discussion of the rationale and methods for defining the comparison group, our difference-in-differences framework, and results of parallel trend tests that informed the selection of our analytic approach
   (see **Section A.1, "Analytic Approach"**)
2. Detailed explanations of the descriptive variables and impact measures that are presented in the Annual Report, covering Quarter 1, 2013 through Quarter 4, 2019
   (see **Section A.2, "Variable and Impact Measure Definitions"**)
3. Information about data acquisition and processing to create the analytic files that are necessary to define the impact measures of interest and conduct the analyses for this Annual Report (see **Section A.3, "Data Sources"**)
4. Step-by-step discussion of how we created the analytic file that we used to generate the results presented in this Annual Report (see **Section A.4, "Analytic File Creation"**)
5. Presentation of a Glossary (see **Section A.5, "Glossary"**)

A.1 Analytic Approach

We designed our quantitative analysis to address the question: What was the effect of the Home Health Value-Based Purchasing (HHVBP) Model on impact measures of interest such as health care utilization, quality of health care, health outcomes, and health care costs. From calendar year (CY) 2016 through CY 2022, home health agencies (HHAs) in Arizona, Florida, Iowa, Massachusetts, Maryland, Nebraska, North Carolina, Tennessee, and Washington are required to participate in the HHVBP Model. These states were selected at random from nine state regional groups defined based on geographic location, utilization, demographics, and clinical characteristics, with each regional grouping containing five or six states.[1] To evaluate the impact of HHVBP by comparing the experience of beneficiaries and HHAs in HHVBP and non-HHVBP states, our empirical model had to address differing characteristics of beneficiaries and HHAs between HHVBP and non-HHVBP groups. Our analyses used data from multiple sources (described in Section A.3) to estimate impacts of HHVBP on the cumulative impact of HHVBP across the nine HHVBP states. Per direction from the Centers for Medicare and Medicaid Services (CMS), we focused on national level findings in this report. Most of the relevant data elements for this evaluation were available for both HHVBP and non-HHVBP groups and both before and after the start of the HHVBP Model (i.e., during both the evaluation baseline period from 2013-2015 and the post implementation period starting in 2016). This allowed for comparing outcomes between HHVBP and non-HHVBP beneficiary populations and assessing whether the relative outcomes for these two groups changed from before to after the start of the HHVBP Model.

Below, we describe the descriptive variables and impact measures used in this report. We then describe our overall analytic approach to construct a comparison group for the impact measures.

A.1.1 Descriptive Variables

An important step for this evaluation was to assess patterns and trends among HHVBP states in the characteristics of home health patients and HHAs and in the utilization of home health services. We compared descriptive measures in HHVBP and non-HHVBP states for individual years before and after implementation of the HHVBP Model. In multiple ways, these analyses informed the design of our analytic approach for evaluating effects of HHVBP. First, we used these analyses to assess the degree of balance between HHVBP states and all non-HHVBP states as a comparison prior to the implementation of the HHVBP Model. In addition, we used these analyses to identify any relevant trends that preceded implementation of HHVBP and any trends that coincided with the post-implementation period. The descriptive variables used for these analyses are defined below in Section A.2.1.

A.1.2 Impact Measures

We note two general reasons why outcomes may differ across HHVBP and non-HHVBP states: 1) differing observed characteristics of beneficiaries and HHAs studied; and 2) differing *un*observed characteristics of beneficiaries and HHAs. Our empirical strategies used information on observed characteristics to address differences between the treated populations (i.e., HHVBP states) and the comparison population (i.e., non-HHVBP states). Specifically, these strategies established a comparison group to address observed differences and the use of a difference-in-differences (D-in-D) framework to address unobserved differences.

[1] See 2015 Final Rule here.

A.1.3 Conceptual Framework

The effectiveness of the HHVBP Model in achieving improved quality for beneficiaries served by HHAs depends on the extent to which it incentivizes HHAs to modify their operations and care delivery in ways that improve the quality of home health care and patient outcomes while controlling or reducing costs to Medicare. Our evaluation emphasizes the collection, analysis, and synthesis of information that is most relevant to how HHAs in the nine model states respond to the HHVBP Model, in comparison to equivalent non-model HHAs throughout the same time period. By using observations of HHAs and the beneficiaries for whom they provide care in non-model states, we attempted to answer the question: What would have occurred in these agencies and for their beneficiaries if the HHVBP Model had not been implemented? Our analyses examined whether the HHVBP Model is achieving its overarching goal—to improve the quality of home health services and efficiency of care—and identify any potential unintended consequences.

The conceptual framework in Exhibit A-1 highlights key pathways for change under the HHVBP Model. This framework informed our approach to addressing the evaluation research questions presented in Section 1 of the Fourth Annual Report. The HHVBP Model's financial incentives aim to incentivize agencies to take steps to improve their performance or otherwise maintain high levels of performance on the measures that determine their total performance scores (TPS). The TPS results for each HHA and their corresponding (and growing) changes in Medicare payments may in turn influence their future behavior. The design of the model encourages agencies to review their performance and make adjustments in response to them. This may include subsequent changes in agency operations designed to raise or bolster performance in certain areas. Additionally, HHVBP payment adjustments may influence agency decisions regarding market entry/exit or perhaps consolidation. Changes in the overall availability of agencies could have implications for the utilization of home health services and beneficiary access to care.

The response of agencies to HHVBP may have implications for the manner in which they arrange for and deliver home health services, which may in turn result in detectable changes in claims and Outcome and Assessment Information Set (OASIS) data for the use of home health services and corresponding Medicare expenditures. Examples of HHA responses to HHVBP may include changes to the frequency, timing, types of visits, or processes of care during home health episodes or the extent to which agencies seek recertification for an additional episode to meet patient needs. HHAs may target changes in services to patients in specific diagnosis categories if they perceive greater potential gains through doing so. In addition to potentially reflecting changes in practice patterns, changes in the delivery of home health services could also have implications for other forms of utilization. For instance, if the quality of care provided by agencies improves, this may reduce the need for utilization of certain resource-intensive services such as avoidable hospitalizations, emergency department (ED) visits, or transfer to a skilled nursing facility (SNF).

Importantly, we expected to observe variation between agencies and between geographic areas in the impact of the model. HHAs will respond differently to the HHVBP Model depending on their individual circumstances. For example, agencies may differ in their perceptions of the financial risks and opportunities related to HHVBP and their readiness to adopt new processes that are designed to improve performance. Some types of agencies may have more limited experience and/or resources to successfully undertake quality improvement initiatives. Depending on factors such as the organizational

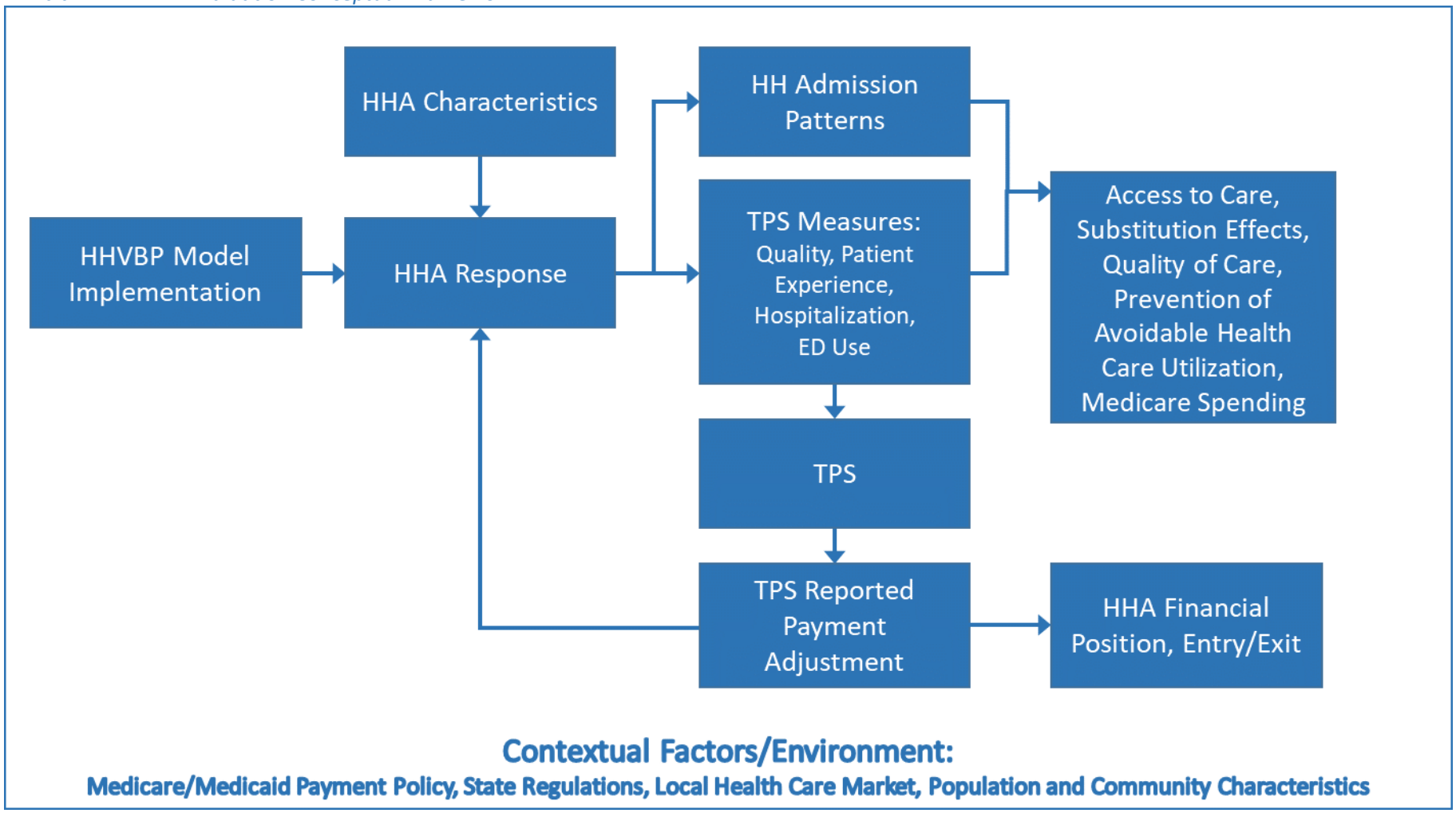
characteristics of these agencies, their characteristics of geographic location and markets, and the types of populations they serve, the HHVBP Model may have a differential impact on certain beneficiary subgroups who tend to receive services from these agencies. This evaluation sheds light on what circumstances are associated with this variation and if there are any areas of concern.

As reflected in Exhibit A-1, the incentives introduced under the HHVBP Model could potentially lead HHAs to make changes in their admission patterns and how they treat particular types of patients. For example, HHAs might avoid initiating episodes for beneficiaries for whom higher quality outcomes in the home health setting may be difficult to achieve. This different profile of patient needs may result in changes in the volume or mix of services used by beneficiaries, which, in turn, may result in changes in overall Medicare expenditures. Thus, it is important to disentangle to what extent changes in observed practice patterns are associated with treating patients differently, such as changing the types of services provided to a particular patient, versus treating different patients (for example by admitting patients with a more favorable case mix).

Our focus in this Report is to examine the impact of the HHVBP Model on cost, quality and utilization after the first four years of implementation (2016-2019). This includes data and supporting analyses for CY 2019, the second year that HHAs in the HHVBP states are subject to positive and negative payment adjustments up to 5 percent. We use data available from CYs 2013-2019 to evaluate the effects of the model on agency performance observed through measures that comprise the TPS as well as examine the impact of larger weights applied to ACH and ED measures in 2019.[2] Additionally, we explored whether entry/exit of agencies have implications for beneficiary access to care, examined potential substitutes to home health services (e.g., SNF visits) among post-acute Medicare FFS beneficiaries and updated Alternative Payment Model (APM) data for the current reporting year. We examined the Model's impact on vulnerable populations (e.g., dual eligible patients, patients in rural areas) and other subgroups of interest (e.g., community referral vs. post-acute care; type of HHA) to explore potential unintended consequences and potential heterogeneity in effects of the model. In later years of the evaluation, as the HHVBP Model progresses, we will further explore the pathways for change under the model as depicted in Exhibit A-1.

[2] See 2018 Final Rule here.

Exhibit A-1. HHVBP Evaluation Conceptual Framework



A.1.3.1 Difference-in-Differences Approach for Impact Measures

We used a D-in-D framework to compare changes in impact measures observed over time in the HHVBP states relative to those in non-HHVBP states as the basis for evaluating the effects of HHVBP. The D-in-D framework offers a quasi-experimental design that can address many threats to validity, and rests on the critical assumption that, in the absence of the HHVBP Model, the impact measures in the two groups would have changed in a parallel manner over time. Our D-in-D analysis compared changes in impact measures observed over time in the HHVBP states combined to corresponding changes in the comparison group. The basic D-in-D estimate was defined as the difference in an outcome of interest over time in the model states, after subtracting the difference, over time, in the comparison group:

$$D\text{-}in\text{-}D = [Y_{INT,POST} - Y_{INT,PRE}] - [Y_{COMP,POST} - Y_{COMP,PRE}]$$

where $Y_{INT,POST}$ and $Y_{INT,PRE}$ are the post- and pre-intervention outcome levels, respectively, for the HHVBP group, and $Y_{COMP,POST}$ and $Y_{COMP,PRE}$ are the post- and pre-intervention outcome levels, respectively, for the comparison group.

With this model specification, the impact estimate is the differential change in an outcome for the HHVBP states between the baseline and follow-up period(s), relative to that same change for the comparison group. That is, the differential change in the outcome over time for the HHVBP states relative to non-HHVBP states represents the estimated effect of HHVBP. The D-in-D design controls for unobserved, time-varying changes that are common to all beneficiaries (i.e., cyclical or seasonal trends or broader changes in the health system) as well as time-invariant, unmeasured differences between HHVBP and comparison states' markets and beneficiary populations. Moreover, through the use of a multivariate regression, we were able to adjust for observed characteristics of beneficiaries influencing the outcome. We also included state fixed effects to account for time-invariant, unobserved differences across states that may correlate with outcomes and with HHVBP participation.

For most of the impact measures of interest for this Annual Report, we used a D-in-D approach to estimate effects of the model for all HHVBP states combined.[3] We implemented this approach in a consistent multivariate linear regression framework for a broad range of impact measures of interest for this evaluation. We provide details regarding the specification of D-in-D models below in Section A.1.5.

A.1.4 Construction of the Comparison Group

A.1.4.1 Background

We continued to use the unified comparison group methodology that we employed in our Second Annual Report. Balancing the HHVBP and comparison groups on factors that impact our outcomes of interest is important to reduce observed differences in the two populations that could lead us to incorrectly infer an effect of HHVBP that is actually a result of differences in the underlying populations. However, there are numerous and diverse impact measures of interest for this evaluation that correspond to different populations (e.g., Medicare fee-for-service [FFS] beneficiaries who receive home health care, all home health patients with Medicare or Medicaid coverage, HHAs) with different underlying factors that affect the outcome. In addition, broader changes are occurring in the home

[3] We were unable to use a D-in-D approach for the three measures that are self-reported by HHAs via the Secure Web Portal since these data are only available for HHAs in the HHVBP states. As such, we instead focused on reporting rates among HHAs in the nine HHVBP states.

health landscape that could have varying implications for each of the impact measures. Together, these factors posed considerable challenges in developing a unified comparison group approach that would achieve balance for *all* impact measures of interest. Therefore, we used a unified comparison group approach that focused balancing efforts on a subset of impact measures of cost, quality and utilization that apply across a diverse group of home health populations relevant to the HHVBP measure set. Prioritizing some impact measures as core to the evaluation allowed us to efficiently determine the best comparison group and covariate adjustment strategy.

We focused on the four HHVBP measures that comprised the Total Performance Score (TPS). The two claims-based HHVBP measures were the Unplanned Acute Care Hospitalization/First FFS Home Health (HH) Episodes, ED Use (no Hospitalization) among First HH Episodes correspond to measures of quality that were both directly incentivized by the model and could be indicators of the quality of home health care. The two OASIS-based HHVBP measures, namely, the Improvement in Ambulation-Locomotion and Discharged to Community covered a broader population than the claims-based HHVBP measures and represented different aspects of quality that are incentivized under HHVBP. The use of the National Quality Forum-endorsed Improvement in Ambulation-Locomotion measure—an indicator of Activities of Daily Living (ADL)—ensured that the comparison group design accounted for functional outcome improvement. The other OASIS measure— Discharged to Community—identified successful discharges to remain at home without formal assistive services. The OASIS items used to define this measure are related to the type of assessment and are less likely to be manipulated than other OASIS-based measures.[4]

Among the measures of Medicare spending, we prioritized Average Medicare Spending per Day during and following FFS HH Episodes of Care, Average Medicare Spending per Day during FFS HH Episodes of Care, Average Medicare Spending per Day following FFS HH Episodes of Care and Average Medicare Spending per Day for Unplanned Acute Care Hospitalizations among FFS HH Beneficiaries. The three measures of average daily Medicare spending were important as they could inform conclusions about the impact of HHVBP on Medicare spending for beneficiaries across a wide range of services both during and following episodes of home health care. We had also included an aspect of spending that related more directly to incentives under the model—spending for unplanned acute care hospitalizations (ACH)—which could reflect any overall changes in spending that resulted from the HHVBP Model.

Together, these few impact measures served as our basis for developing a simplified, more unified comparison group approach for this evaluation. As discussed below, the methodology we employed to establish a valid comparison group for these measures was then applied to other outcomes of interest, while also allowing for a degree of flexibility where supported by a theory and empirical evidence.

A.1.4.2 Comparison Group

We designed the quantitative analyses for this report to evaluate the effect of the HHVBP Model on a range of impact measures that included Medicare spending, utilization of services, quality of care, and

[4] For example, the two OASIS items used in constructing the measure are not as subjective as other OASIS-based measures. First, Reason for Assessment (M0100) must indicate that the assessment is a discharge assessment and not a transfer to an inpatient facility, or death at home, and differing items are to be collected. Second, Discharge Disposition (M2420) is used and indicates that the individual remained in the community after discharge, either with or without formal assistance.

patient experience. As discussed above, we prioritized a subset of impact measures as we developed and tested the design of our overall approach, which we then extended to other impact measures of interest. To facilitate the interpretation of findings across measures, we established a common comparison group approach for our analyses. These analyses involved comparisons for both beneficiaries and agencies between HHVBP and non-HHVBP states.

As important aspects of the design of the HHVBP Model, the randomized selection of nine HHVBP states and mandatory participation of all HHAs in these selected states helped to guard against selection bias. As reflected in the results of our descriptive analyses (see Section C.1 below), we found that the model design achieved reasonably close balance between HHVBP states and the remaining states in many beneficiary and agency characteristics, and aspects of home health care. Given the extent of diversity in beneficiary and agency characteristics and treatment patterns across states, not all factors were balanced between the two groups through randomization alone, with a degree of imbalance observed for certain factors.

Given the design attributes of randomization and mandatory participation and the degree of balance observed for a range of factors, we defined a single comparison population consisting of beneficiaries and agencies in the 41 states not selected for participation in the HHVBP Model.[5] We used a multivariate linear regression approach to compare observations in the nine HHVBP states with those in the 41 comparison states while adjusting for a common set of covariates across measures to the extent possible. In the context of a parametric regression framework, we controlled for observed differences between the HHVBP and comparison groups, generated a D-in-D estimator, and examined adjusted baseline differences for consideration of the estimator's key parallel trend assumption.

To address the various research questions of interest for this evaluation given the goals of the HHVBP Model and the incentives reflected in the HHVBP performance measures, we used this analytic approach and single comparison group to examine a range of impact measures for this report. These impact measures are enumerated below in Exhibit A-2.

[5] The evaluation restricts comparisons to the 41 non-HHVBP states and excludes the District of Columbia and U.S. territories, as they were not eligible for selection into the HHVBP Model.

Exhibit A-2. Impact Measures Used to Evaluate the HHVBP Model

Measure	Unit of Analysis
HHA Total Performance Score (TPS)[a] (Section 5)	HHA-Level
Home Health Utilization Measures (Section 3)	
Percent of FFS Beneficiaries with at Least One HH Episode	County-year
Number of HH Episodes per 1,000 FFS Beneficiaries	County-year
FFS Claims-Based and OASIS-Based Case-Mix Measures (Section 3)	
HCC Score at the Start of Care	FFS Episode-Level
Total Normalized Composite (TNC) Mobility at Start of Care	OASIS Episode-Level
Total Normalized Composite (TNC) Self-care at Start of Care	OASIS Episode-Level
FFS Claims-Based Measures Examining Post-Acute Care (Section 3)	
Home Health Care	FFS Hospital Discharge-Level
Skilled Nursing Facility	FFS Hospital Discharge-Level
Inpatient Rehabilitation Facility	FFS Hospital Discharge-Level
Hospital Outpatient Therapy	FFS Hospital Discharge-Level
None (i.e. Self-Care)	FFS Hospital Discharge-Level
FFS Claims-Based HHA Operations Measures (Section 4)	
Number of Skilled Nurse Visits During First 2 Weeks	FFS Episode-Level
Number of Therapy Visits During First 2 Weeks	FFS Episode-Level
Frontloading Skilled Nurse Visits	FFS Episode-Level
Frontloading Therapy Visits	FFS Episode-Level
FFS Claims-Based Utilization Measures (Section 6)	
Unplanned Acute Care Hospitalization/First FFS HH Episodes	FFS Episode-Level
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes	FFS Episode-Level
ED Use followed by Inpatient Admission/First FFS HH Episodes	FFS Episode-Level
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes	FFS Episode-Level
Unplanned Acute Care Hospitalization/All FFS HH Episodes	FFS Episode-Level
Skilled Nursing Facility (SNF) Use/All FFS HH Episodes	FFS Episode-Level
Causes of FFS Claims-Based Hospitalization Measures[b] (Section 6)	
Rehospitalization (overall)	FFS Episode-Level
Medical Rehospitalization for Same MDC as Index Hospitalization	FFS Episode-Level
Medical Rehospitalization for Different MDC as Index Hospitalization	FFS Episode-Level
FFS Claims-Based Spending Measures[c] (Section 7)	
Average Medicare Spending per Day during and following FFS HH Episodes of Care	FFS Episode-Level
Average Medicare Spending per Day during FFS HH Episodes of Care	FFS Episode-Level
Average Medicare Spending per Day following FFS HH Episodes of Care	FFS Episode-Level
OASIS-Based Outcome Quality Measures (Section 8)	
Discharged to Community	OASIS Episode-Level
Total Normalized Composite (TNC) Change in Self-Care	OASIS Episode-Level
Total Normalized Composite (TNC) Change in Mobility	OASIS Episode-Level
Improvement in Dyspnea	OASIS Episode-Level
Improvement in Management of Oral Medications	OASIS Episode-Level
Improvement in Pain Interfering with Activity	OASIS Episode-Level

Measure	Unit of Analysis
Improvement in Status of Surgical Wounds	OASIS Episode-Level
FFS Claims-Based Quality Measure (Section 8)	
Mortality Rate/All FFS Home Health Episodes	FFS Episode-Level
HHCAHPS-Based Patient Experience Measures (Section 9)	
How often the home health team gave care in a professional way (Professional Care)	HHA-Level
How well did the home health team communicate with patients (Communication)	HHA-Level
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)	HHA-Level
How do patients rate the overall care from the home health agency (Overall Care)	HHA-Level
Would patients recommend the home health agency to friends and family (Likely to Recommend)	HHA-Level

Section numbers refer to corresponding sections in the report. HHVBP Measures indicated by italic text. |As discussed in Section 1.2 of the report, in 2019 CMS removed all OASIS process measures and replaced three of the OASIS outcome measures with the two composite measures (See Exhibit 2 in the report). | We do not include the three measures that are self-reported by HHAs since these are only available for HHAs in the HHVBP states. | All measures have a baseline period of 2013-2015 except for HHA Total Performance Score which has a baseline period of 2015.

[a] As discussed in Section 2.2.2 of the report, a D-in-D approach is not used for analysis of agency TPS.

[b] We also analyzed hospitalization measure stratified by 8 MDC categories and by surgical vs medical types.

[c] For each of the three spending measures, we also analyze their components: Medicare Part B carrier and DME combined, HH, Hospice, Inpatient, Outpatient ED and Observation Stays, other Outpatient, Outpatient types combined, and SNF.

A key step in designing our regression-based comparison group approach was to select factors for covariate adjustment. We considered a combination of several criteria in selecting factors for inclusion in the regression analyses. While not every factor that was chosen was equally preferred based on each criterion, each factor that was chosen was seen as having advantages for inclusion when balancing among these various criteria and in achieving unbiased estimates of the effects of HHVBP. Below we describe the criteria used in selecting potential factors for covariate adjustment:

- ***Adoption of a uniform analytic approach.*** To the extent possible, we sought to adjust for similar factors in examining the range of impact measures that are of interest for this evaluation. We used this strategy to facilitate interpretation of the estimated effects of HHVBP across numerous impact measures.
- ***Availability of data across multiple populations of interest.*** In particular, while data reported in OASIS were reported for all home health patients with Medicare or Medicaid coverage, there was other information that could be obtained only from Medicare claims or other CMS data sources for Medicare FFS beneficiaries and were therefore not available for analysis of OASIS-based impact measures. In seeking a relatively uniform analytic approach, we therefore sought to limit the selection of factors available for Medicare FFS beneficiaries only unless there was a compelling rationale based on other criteria.
- ***Degree of imbalance between HHVBP and non-HHVBP states.*** As a result of the randomized selection of states for participation in the HHVBP Model, there were many similarities between HHVBP and non-HHVBP states during the baseline period. However, there were larger differences between the two groups in certain beneficiary and agency characteristics. We

described baseline differences in such factors in the report (e.g., patient race/ethnicity and rural location) and included them as covariates to achieve balance.

- ***Relationship with impact measures of interest for this evaluation.*** Factors found to have a relatively strong relationship with certain impact measures and/or to have a relationship with multiple impact measures of interest were given greater emphasis, provided they also satisfied other criteria.
- ***Differential trends in HHVBP and non-HHVBP states prior to the implementation of the HHVBP Model.*** Factors exhibiting such trends may be both exogenous to the HHVBP Model and pose a greater risk of introducing bias should their baseline trends extend into the post-HHVBP period. The extent of this risk also depended on other criteria, such as the strength of their relationship with the impact measures. Adjustment for such factors may help to satisfy the parallel trends assumption of our D-in-D approach.
- ***Potential endogeneity.*** We sought to avoid selection of factors that were endogenous to the HHVBP Model. For example, adjustment for clinical characteristics of patients influenced by the quality of prior home health care may lead to biased estimates of the effects of HHVBP. To minimize this risk, we used caution in selecting factors that changed differentially for HHVBP and non-HHVBP states between the pre-implementation and post-implementation periods, unless such differential trends were evident during the pre-implementation period and it was supported by other criteria.
- ***Degree of subjectivity in measurement.*** We also sought to avoid factors reported by agencies perceived as being subjective measures of patient status and are therefore more susceptible to changes over time in reporting. We note that in certain instances, other considerations such as the strength of the relationship with patient outcomes were given precedence. This was relevant when considering the initial status corresponding to each of the OASIS outcome improvement measures (e.g., improvement in ambulation), where there is often a degree of subjectivity in determining the patient's initial status.
- ***Correlation with other factors being considered for covariate adjustment.*** We did not select factors strongly correlated with other factors that were preferred as covariates based on other criteria.

Beginning in January 2019, the OASIS assessment form was updated from version C2 to D, which included the removal of four questions (without replacement) that the HHVBP Evaluation used as covariates in our D-in-D analyses in the Third Annual Report. Omitting these four OASIS-based covariates from the D-in-D model caused our two unplanned acute care hospitalization measures (Unplanned Acute Care Hospitalization/First FFS HH Episodes and Unplanned Acute Care Hospitalization/All FFS HH Episodes) to fail the falsification test, which indicated lack of parallel trends in the baseline period (2013-2015) between the HHVBP and non-HHVBP states. The parallel trends assumption is critical to support valid inferences about the impact of HHVBP for the D-in-D models. In contrast, we found that the omission of these four OASIS-based covariates did not materially affect our findings for the OASIS-based outcome measures. Hence it became necessary for us to revise and update the covariate list used in the D-in-D model specification specifically for the claims based measures.

Using the above criteria, we examined several potential covariates with a goal of finding conceptually similar substitutes for the four unavailable OASIS covariates in order to achieve balance in the baseline period between the HHVBP and non-HHVBP states and importantly to satisfy the parallel trends

assumption for the measures. The process of selecting covariates based on these criteria resulted in (a) a core set of covariates that were used for analyses of a broad range of impact measures and (b) the inclusion of a relatively small number of additional covariates for the analysis of either a particular impact measure or of a related group of impact measures. In the following sections, we describe both the core set of factors that were used for covariate adjustment as part of our standard model specification (listed in Exhibit A-3) and the additional covariates or other refinements that apply to a subset of impact measures.

Exhibit A-3. Core Set of Factors for Covariate Adjustment for FFS Claims and OASIS Outcome Measures

Beneficiary Characteristics
Age
<65 years
65 – 84 years
85 years and older
% Female
Race/Ethnicity (Mutually Exclusive)
Hispanic (regardless of black/white/other race)
Non-Hispanic Black
Non-Hispanic White
Non-Hispanic Other
Non-Hispanic Multiracial
% Dual eligible
% Rural
% of Persons in the Patient's County of Residence who are Ages 25 years and Older with Less than a High School Diploma
Alignment with selected APMs
BPCI-Model 2
BPCI-Model 3
BPCI Advanced
CJR
MSSP
Next Generation ACO
OCM
Pioneer ACO
Agency Characteristics
Ownership
For-profit
Non-profit
Government-owned
Setting
Hospital-based
Freestanding
Chain affiliation
Yes
No
Missing
Undetermined
HHA Age
<4 years

Agency Characteristics
4-10 years
>10 years
Agency Size: Number of OASIS episodes
1-59
60-249
250-499
500-999
1000+
Core Clinical Indicators Used for Episode-Level Impact Measures*
Ambulation and Locomotion
Able to independently walk with the use of a one-handed device
Requires two handed device for level ground or human assistance for stairs and uneven ground
Walks only with supervision or assistance from another at all times
Chairfast to bedfast
Interaction of HHVBP (treatment) indicator with each of the four levels of Ambulation and Locomotion
Risk for Hospitalization
Multiple hospitalizations in past 6 months
History of falls
Currently taking 5 or more medications
Surgical Wound
Requires urinary catheter
Discharged from Inpatient Facility in last 14 Days
Pressure Ulcer
Pressure Ulcer Stage 2
Pressure Ulcer Stage 3
Pressure Ulcer Stage 4
Pressure Ulcer Not Stageable
Neoplasm Diagnosis

**Derived from OASIS assessment at start of home health care.*

As noted above, this core list of model covariates was, in certain instances, augmented or otherwise refined for analyses of specific impact measures. In each case, the criteria described above were used in determining whether there was a rationale for inclusion or exclusion of specific covariates. However, these additional covariates were not included among the core list of covariates either because they were obtained from a data source that was not available for the entire population of interest, the rationale for inclusion only applied to a subset of impact measures, or for other reasons given below.

Covariate Refinements

FFS Claims-Based Utilization, Causes of Hospitalization, Spending Measures, HHA Operations measures

As explained above, a D-in-D model omitting the four OASIS assessment variables that were no longer being collected in 2019 adversely affected the parallel trends assumption for the claims-based impact measures. Hence along with the core list of covariates (Exhibit A-4) we included the following covariates that helped to achieve balance in the baseline period between the HHVBP and non-HHVBP states and importantly, satisfied the parallel trends assumption for the measures (Exhibit A-4).

Exhibit A-4. Claims-based Substitutes for the Four OASIS Questions Unavailable as of 2019

New Claims Based Covariates
Oxygen indicator
PDGM home health admission source
PDGM defined Clinical grouping

- ***Oxygen indicator:*** Replacement for the OASIS-based oxygen variable, using a combination of: primary and secondary diagnoses for supplemental oxygen reported on home health, DME, outpatient, physician-supplier, and inpatient claims, as well as OASIS Assessment items M1021 (primary diagnosis) and M1023 (secondary diagnoses). For more details please refer to Section A2.1.1.
- ***Home health admission source*** used as part of the Patient-Driven Groupings Model (PDGM), indicating the healthcare setting utilized in the 14 days prior to the home health admission: inpatient acute care hospital, skilled nursing facility, inpatient rehabilitation facility, long term care hospital, inpatient psychiatric facility) or community. This information was obtained using the Health Insurance Prospective Payment System (HIPPS) codes (position 1) reported on the home health claims. For more details please refer to Section A.2.1.2.
- ***Clinical grouping*** used as part of the PDGM, using the principal diagnosis reported on the home health claim. The clinical group assignment identifies the primary reason for home health services. There are 12 total clinical groups used in the PDGM. This information was obtained using the HIPPS codes (position 2) reported on the home health claims. For more details please refer to Section A.2.1.2.

Additionally, we adjusted for end-stage renal disease (ESRD) or disability as the reason for Medicare entitlement, for which comparable information was not available for non-Medicare patients. For more details please refer to Section A.2.1.1.

These factors were specified as additional covariates based on the strength of their relationship with a range of claims-based impact measures and inexact balance between HHVBP and non-HHVBP groups. Other potential adjustment factors that we considered but ultimately not included as they did not help in improving the performance of the D-in-D models, were potential claims-based alternatives for the remaining three OASIS data elements that were dropped from the OASIS assessment starting in 2019

(psychiatric nursing services, non-surgical wound or skin lesion, and orthopedic conditions), indicators of Hierarchical Condition Categories (HCCs), and measures of comorbidity burden and functional impairment status used for the PDGM.

For the four HHA operations (frontloading) measures, we additionally adjusted for number of ED visits occurring within that two-week time-frame. This was done in order to control for potential confounding between ED use that may prohibit some early home health visits while also indicating greater likelihood to use the ED after the initial two weeks of care.

OASIS-Based Outcome Quality Measures

For OASIS episode-level impact measures, we added an adjustment for Medicaid coverage among patients who were not reported as being dually eligible for Medicare and Medicaid. This covariate was not applicable for analysis of claims-based impact measures, which are limited to Medicare FFS beneficiaries.

For each of the four OASIS-based outcome improvement measures, which were used to assess improvement over time in patient functioning or other clinical characteristics, we adjusted for outcome-specific start of care indicators of patient status. More specifically, we adjusted for the indicator of a patient's status from the initial OASIS assessment corresponding to the OASIS outcome of interest being examined. In selecting these relevant initial status indicators as covariates, we considered multiple factors. First, in our analyses of each of these measures, we found a relatively strong positive relationship of greater initial impairment or severity with greater improvement over time in patient status (i.e., such that there was greater opportunity for improvement). In addition, for many of these measures, there was a notable trend towards higher levels of impairment being reported at initial assessment that began during the pre-implementation period. These pre-implementation trends may have reflected agency efforts to increase accuracy in coding in response to public reporting initiatives. Given these considerations, we determined that inclusion of these outcome-specific covariates would allow us to avoid omitted variable bias related to the patient's initial status reported in OASIS.

Additionally, we included an interaction term between the outcome-specific start of care variables and the HHVBP (i.e., treatment) indicator to account for any differences in coding of patient status at the start of care between HHVBP and non-HHVBP states. For example, when modeling improvement in dyspnea, we adjusted for the initial level of dyspnea status and also interacted indicators of the level of dyspnea status with the HHVBP indicator. We used a similar approach in analyzing each of the other OASIS-based improvement measures.

For the two new Total Normalized Composite (TNC) change in Self-Care and change in Mobility measures, we followed the exact same rules. Since these are composite measures, the start of care values ranged from 0-23 for the TNC Change in Self-Care measure and 0-15 for the TNC Change in Mobility measure. The range of values for each composite measure were then grouped into four categories and included as covariates in the model. Consistent with other OASIS outcome measures, we also included interaction terms between the TNC measure-specific start of care categories and the HHVBP (i.e., treatment) indicator for these two measures to account for any differential coding in patient status between the two groups. See Section A.2.1 for details.

Home Health Utilization Measures

The denominator for these two home health utilization measures is total number of Medicare-eligible FFS beneficiaries residing in a county in a particular year. Hence we did not adjust for any covariates derived from home health beneficiaries listed in Exhibit A-3.

FFS Claims based and OASIS based Case-Mix Measures

We only adjusted for the agency characteristics as listed in Exhibit A-3 for these three impact measures. We did not control for beneficiary characteristics or clinical characteristics as the focus was to evaluate the changes in case-mix of home health beneficiaries and controlling for these factors that reflect patient clinical severity could potentially bias the estimated effects.

FFS Claims-Based Measures Examining Post-Acute Care

These five measures were adjusted for only a subset of factors listed in Exhibit A-3, namely age, rural indicator, ACO SSP and ACO Pioneer APM flags. The unit of analyses for these measures are hospital discharges.

HHA Level Impact Measures

We examined two distinct sets of HHA-level impact measures: agency TPS and Home Health Consumer Assessment of Healthcare Providers and Systems (HHCAHPS)-derived measures. For analyses of these measures, we included all of the core beneficiary characteristics (aggregated to the agency level) and agency characteristics listed in Exhibit A-3 as covariates, with a few exceptions. For HHCAHPS measures, we excluded patient age and area education variables since comparable factors were already accounted for in the risk adjusted HHCAHPS measure values. Additionally, we did not specify OASIS episode characteristics (aggregated to the agency level) as covariates for analyses of the HHA-level impact measures, given that each of these measure values already reflected risk adjustment based on any clinical factors that were deemed relevant to measuring agency performance under HHVBP.

Further details regarding how individual covariates were defined for inclusion in regression analyses are provided in Section A.2.1

Adjustment for Alternative Payment Models

Other CMS initiatives and alternative payment models (APMs) have potential to impact HHA operations and beneficiaries' use of home health services. Like last year, we had access to secondary data sources for a number of APMs that enabled us to investigate their potential impact and how best to account for such external factors in our analyses. The relevant APMs that were active during 2013-2019 and for which we had data available were: the Bundled Payment for Care Improvement (BPCI) Initiative, the Comprehensive Care for Joint Replacement Model, the Oncology Care Model (OCM), and Accountable Care Organization (ACO)-centered models, including the Medicare Shared Savings Program (MSSP), the Pioneer ACO Model, and the Next Generation ACO Model.

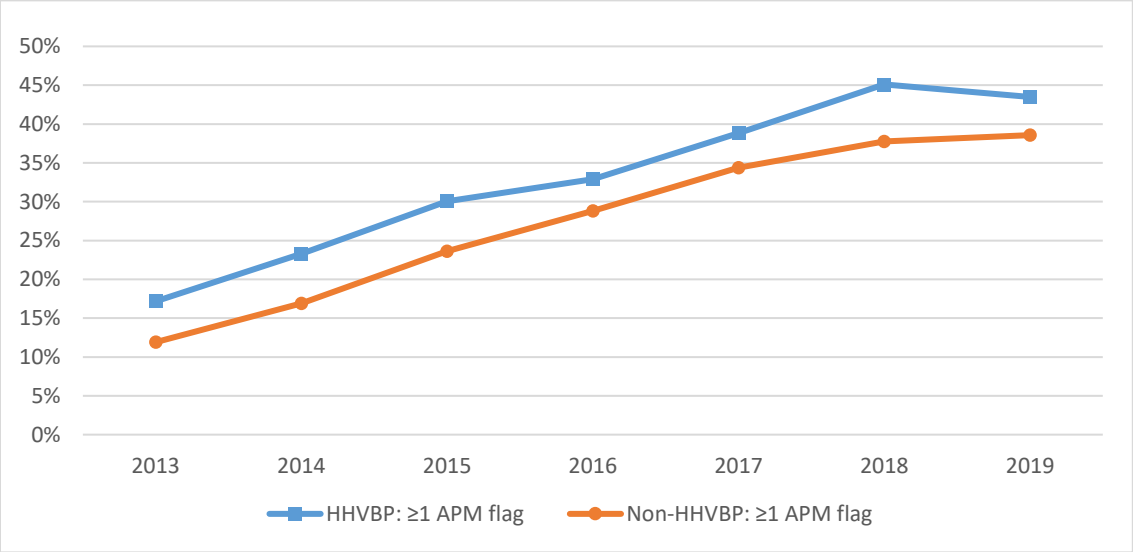
Home health beneficiaries participating in APMs may have a different course of care than home health beneficiaries not aligned with APMs. For example, under the voluntary BPCI, participating acute care hospitals and post-acute care providers receive bundled payments for services rendered during a defined episode of care, such that these providers are incentivized to contain costs and improve the quality of care. Like BPCI, the CJR Model requires coordination between participating hospitals and physicians and post-acute care providers, as beneficiary alignment to the model (and the hospital's financial responsibility for patient outcomes) begins with lower extremity joint replacement (LEJR) and

continues through a 90-day post-acute period. This model was mandatory for hospitals within 67 selected MSAs for the first two years and voluntary thereafter. Similarly, since the enactment of the Affordable Care Act, CMS has established a number of ACO-APMs tasked with improving coordination and quality of patient care, often under a dual-sided financial risk- and reward-based agreement with CMS. Through participation in the OCM, practitioners assume financial risk on a voluntary basis over the course of a beneficiary's chemotherapy care, with the goal of improving care coordination and ultimately patient outcomes.

As shown in Exhibit A-5, there is an increasing trend in the share of home health episodes linked to an APM over the course of the evaluation period in both HHVBP and non-HHVBP states, with home health episodes in HHVBP states showing consistently higher APM penetration than non-HHVBP episodes. In 2013, 17.2 percent of home health episodes were aligned with one or more APM in HHVBP states, compared to 11.9 percent in non-HHVBP states. By the first performance year (2016) of the HHVBP Model, APM penetration had increased to 32.9 percent in HHVBP states and 28.8 percent in non-HHVBP states. In 2019, 43.5 percent of home health episodes in HHVBP states were aligned to one or more APMs compared to 38.6 percent of non-HHVBP episodes. The increase in APM penetration over time is partially attributable to the growth in the number of active APMs, which peaked in 2016 when the MSSP, the Pioneer ACO Model, the Next Generation ACO, BPCI Models 2 and 3, CJR, and OCM were all active.

Therefore, to account for these initiatives which may affect HHA performance under HHVBP, we adjusted for beneficiary alignment to APMs at any time during their home health episode in our D-in-D regression model (information on APM alignment was only available for FFS claims-based episodes). Additional information on the APMs used in our covariate list are outlined in Sections A.2.7, A.3.12, and A.3.13 below.

Exhibit A-5. APM Penetration among Home Health Episodes for FFS Beneficiaries in HHVBP and Non-HHVBP States, 2013 – 2019



State Fixed Effects

In general, given the random selection of the states into the HHVBP model, the D-in-D approach (as described above) helps to control for unobserved time-invariant heterogeneity in the treatment model.

However, to control for residual time-invariant confounding and to limit selection bias in the estimation of causal effects, we adjusted for a full set of state fixed effects in the D-in-D model specification. By exploiting within-group variation over time, fixed effects regression is a powerful tool for mitigating the risk that omitted variables drive any associations between dependent and independent variables.

As was done in the Third Annual Report, we also analyzed impact measures at the state level. Section A.1.6 below describes the comparison group for each of the nine HHVBP states.

A.1.5 Difference-in-Differences Model

With a baseline period for analysis of 2013-2015, we used a D-in-D model to estimate yearly average treatment effects separately for the four post-implementation years, 2016, 2017, 2018 and 2019. We also estimated a cumulative average effect over all four years (2016 – 2019).

A.1.5.1 Yearly Difference-in-Differences Estimator

We included data for all the years (2013 – 2019) to obtain the individual yearly HHVBP estimates in the post-implementation period, i.e. D-in-D estimates for 2016, 2017, 2018 and 2019 and also to calculate the cumulative average effect over 2016 – 2019.

Defining each episode *i* in time *t*, identifying the treatment episodes with an indicator variable $Treat_i$, identifying the post-implementation year variables *t* with an indicator variable $I(t = t_k)$, and identifying a vector of covariates as $\mathbf{P}_{Cov}$ (defined in Section A.1.4), the D-in-D estimator for outcome *Y* is implemented as:

$$Y_{i,t} = \alpha_0 + \alpha_1 Treat_i + \sum_{k=1}^{k=4} \beta_k I(t = t_k) + \sum_{k=1}^{k=4} \delta_k Treat_i * I(t = t_k) + \sum_{j=1}^{j=3} \rho_j I(q = j) + \omega \mathrm{P}_{Cov} + \sum_{s=3}^{s=50} \theta_s I(S = s) + \epsilon_{i,t}$$

Where *k* indexes the HHVBP Model years 1 to 4 (calendar years 2016 – 2019).

- $Treat_i$: 1, 0 indicator (1= HHVBP states, 0= Non-HHVBP states)
- $I(t = t_1)$: 1 , 0 indicator (1 when year = 2016, 0 otherwise)
- $I(t = t_2)$: 1 , 0 indicator (1 when year = 2017, 0 otherwise)
- $I(t = t_3)$: 1 , 0 indicator (1 when year = 2018, 0 otherwise)
- $I(t = t_4)$: 1 , 0 indicator (1 when year = 2019, 0 otherwise)
- α_0 is an intercept
- α_1 is the average difference between the HHVBP and comparison populations over the pre-implementation period
- β_k is the average change from pre- to post-implementation for the HHVBP population, where *k* = 1 for year 2016, *k* = 2 for year 2017, *k* = 3 for year 2018, k = 4 for year 2019
- δ_k is the yearly D-in-D effect, for *k* = 1, 2, 3, 4; the difference in the change from pre-implementation to post-implementation for the HHVBP population relative to the comparison population (i.e., to estimate the treatment effect of HHVBP)
- ρ_j coefficients capture seasonal effects associated with the four quarters of the year, where *j* = 1, 2, 3 (one quarter omitted as reference)
- ω is a vector of coefficients associated with vector of covariates $\mathbf{P}_{Cov}$

- $I(S = s)$: 1, 0 indicator (1 when from state *s*, 0 otherwise); two states omitted as reference since "treat" is also included in the model
- θ_s coefficients are fixed effects for each state *s*
- $\epsilon_{i,t}$ episode-specific error term.

In the regression equation, we included three estimates (ρ_1, ρ_2, ρ_3) capturing quarterly effects since we included a constant in the equation. Each episode was given an equal weight except for the four average Medicare spending per day measures, which were appropriately weighted by the number of days included in the denominator (see Section A.2.2). In order to obtain the average annual (cumulative) impact estimate over the four HHVBP Model years (i.e. 2016 – 2019), we calculated a linear combination of the three year-specific impact estimates with each year's impact weighted by the number of episodes in that year, or in the case of the spending measures, weighted by the sum of denominator days in all states for the year.

Given the phase-in structure of the payment adjustments of the HHVBP model, we compared the average estimated HHVBP impacts on the measures in 2018 – 2019, when HHAs received performance-based payment adjustments, to the average impact during HHVBP Model years 2016 – 2017, prior to payment adjustments. We estimated and tested the equivalence of the following linear combinations of the earlier and later post-implementation years:

$$w_1\delta_1 + w_2\delta_2 = w_3\delta_3 + w_4\delta_4.$$

where weights are constructed based on the number of episodes (or days for the spending measures) in that year and normalized such that $w_1 + w_2 = 1$ and $w_3 + w_4 = 1$. Standard errors were clustered at the agency-level because implementation of HHVBP directly impacts HHAs. Since home health episodes within the same agency are correlated, accounting for agency clusters protects against the potential underestimation of standard errors, thereby minimizing the risk that we make false positive inferences about the effect of HHVBP. We also stratified at the state level in the model to account for greater homogeneity within states than across states, i.e. the variance of the outcome variable potentially being smaller within the state than in the population as a whole. Given that the HHVBP effect is analyzed at the national level and all HHA clusters are nested within states, stratification is a method of breaking up the population into different groups and accurately estimating the standard error of the estimates. Stratification exploits this homogeneity within states to produce smaller standard errors for a given overall sample size, thus minimizing the risk of false negative inferences (Type 2 errors) from hypothesis tests.

The derivation of the mean outcome in the HHVBP and comparison group by pre- and post-implementation period is presented below. The D-in-D estimators for 2016, 2017, 2018 and 2019 are given by the coefficients δ_1, δ_2, δ_3 and δ_4 respectively. Between-group differences changed from α_1 in the pre-implementation period to $\alpha_1 + \delta_k, k = 1,2,3,4$ in the post-implementation period. The D-in-D coefficient,δ_k, indicates whether between group differences increased ($\delta_k > 0, k = 1, 2, 3, 4$) or decreased ($\delta_k < 0, k = 1, 2, 3,4$) after implementation of HHVBP.

Exhibit A-6. Difference-in-Differences Estimators for Individual Post-Implementation Years

Group	Pre-Implementation	Post-Implementation	Pre-Post Difference
2016 Difference-in-Differences Estimator			
HHVBP	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \beta_1 + \delta_1$	$\beta_1 + \delta_1$
Non HHVBP	α_0	$\alpha_0 + \beta_1$	β_1
Between group	α_1	$\alpha_1 + \delta_1$	δ_1
2017 Difference-in-Differences Estimator			
HHVBP	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \beta_2 + \delta_2$	$\beta_2 + \delta_2$
Non-HHVBP	α_0	$\alpha_0 + \beta_2$	β_2
Between group	α_1	$\alpha_1 + \delta_2$	δ_2
2018 Difference-in-Differences Estimator			
HHVBP	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \beta_3 + \delta_3$	$\beta_3 + \delta_3$
Non-HHVBP	α_0	$\alpha_0 + \beta_3$	β_3
Between group	α_1	$\alpha_1 + \delta_3$	δ_3
2019 Difference-in-Differences Estimator			
HHVBP	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \beta_4 + \delta_4$	$\beta_4 + \delta_4$
Non-HHVBP	α_0	$\alpha_0 + \beta_4$	β_4
Between group	α_1	$\alpha_1 + \delta_4$	δ_4

We calculate the cumulative estimate as the weighted average of the yearly estimates to ensure that the cumulative estimate is consistent with the yearly D-in-D estimates. We calculated the weights for each of the measure domains as follows:

- For the claims-based utilization measures: the proportion of total claims episodes accounted by each year
- For the claims-based Medicare spending measures: the proportion of total episode-days accounted by each year
- For OASIS-based outcome measures: the proportion of total OASIS episodes accounted by each year
- For the HHCAHPS-based measures: the proportion of total agency-years accounted by each year

As deemed appropriate, we have plotted trends in risk-adjusted values of the measures using the parameter estimates of the multivariable D-in-D model and average value of all the covariates (calculated using all episodes or episodes belonging to a particular subgroup depending on the analyses). For example, we examined the risk-adjusted trend lines of the Mortality Rate/All FFS Home Health Episodes measure based on the multivariable D-in-D model between HHVBP and non-HHVBP states over 2013 – 2019 (See Exhibit C-50).

A.1.5.2 Parallel Trends Testing

As discussed above, our primary analytic approach involved the use of a D-in-D estimator to measure the effects of HHVBP on a range of measures. With this estimator, we measured treatment effects based on changes occurring between the pre- and post-implementations periods in the nine HHVBP states relative to those occurring in the 41 comparison group states. We used a multivariate linear regression framework to adjust for key factors (i.e., Exhibit A-3) that remain imperfectly balanced between the two groups in a context of randomized selection and mandatory participation.

A key assumption with the D-in-D estimator is that the change in outcomes experienced in the comparison population is an accurate portrayal of the change that would have occurred in HHVBP states

in the absence of HHVBP, also known as the parallel trends assumption. While the counterfactual of what would have occurred in the absence of HHVBP cannot be observed, we examined whether the measures of interest moved similarly over the baseline period (2013 to 2015) in the nine HHVBP states and the 41 comparison states. That is, we compared relative trends in these measures for the HHVBP and comparison groups during the three years prior to the implementation of HHVBP.

We conducted these analyses with two goals in mind. First, we used the results of these analyses to help inform our analytic approach, and specifically decisions about model covariate selection. As discussed above, one of the criteria we considered as the basis for selecting covariates for adjustment was the presence of differential trends between the HHVBP and comparison groups during the baseline period. We used analyses of baseline trends in impact measures to ascertain how well a particular model specification satisfied the parallel trends assumption. With the results of these analyses, we were able to consider whether certain types of covariates helped to strengthen the validity of this assumption. We considered such benefits in conjunction with any tradeoffs where the inclusion of additional covariates increased complexity and a lack of uniformity in our approach across impact measures. Secondly, beyond informing the design of our analytic approach, the results of these analyses also helped us to determine our level of confidence in using the resulting D-in-D estimator to make inferences about the effects of HHVBP as well as potentially motivating the exploration of alternative model specifications.

To accomplish these goals, we performed two types of analyses of parallel trends that adjust for our core set of covariates (i.e., Exhibit A-4) along with state fixed effects. Each type of analysis is discussed in turn below.

Comparison of Annual Trends between HHVBP and Non-HHVBP States

To assess parallel trends, we compared annual trends in impact measures between HHVBP and non-HHVBP states. We calculated the difference in means of the adjusted measure values for HHVBP and non-HHVBP states across the individual years of the baseline period (2013 – 2015) as well as for the implementation period (2016 – 2019). Similarly, we also calculated the difference in means of the unadjusted measure values for the two groups across the individual years. We assessed parallel trends for two FFS claims-based quality measures, three OASIS-based quality measures (which includes the two new TNC measures) and three measures of FFS claims-based Medicare spending.

For each of these eight impact measures, we plotted the differences in both unadjusted and covariate-adjusted (with state fixed effects) measure values between HHVBP and non-HHVBP states in each year (with the difference calculated as the estimated HHVBP measure value minus the estimated non-HHVBP measure value). We examined the slopes of the plotted lines for each measure during 2013 – 2015, and compared results based on an unadjusted regression model (i.e., having no beneficiary or agency characteristics as covariates) with results based on the adjusted model using the core set of covariates listed in Exhibit A-3 along with state fixed effects. Slopes of the plotted lines that were close to zero during 2013 – 2015 would indicate that impact measures for the two groups moved in a parallel manner over the baseline period.

We display results using plots of the difference in yearly means for each of eight impact measures (Exhibit A-6), grouped as FFS claims-based quality measures, OASIS-based quality measures, and FFS claims-based Medicare spending measures. To facilitate interpretation of results across impact measures, the y-axis scales for the eight plots in Exhibit A-7 are standardized such that the difference between the minimum and maximum values shown on each y-axis corresponds to a difference of

approximately 20 percent of the mean measure value for HHVBP and non-HHVBP states combined during 2013-2015. For example, the difference between the minimum and maximum values on the y-axis for the unplanned ACH measure plot (1.5 percent – (-1.5 percent) = 3.0 percent) corresponds to approximately 20 percent of the national average hospitalization rate of 16 percent.

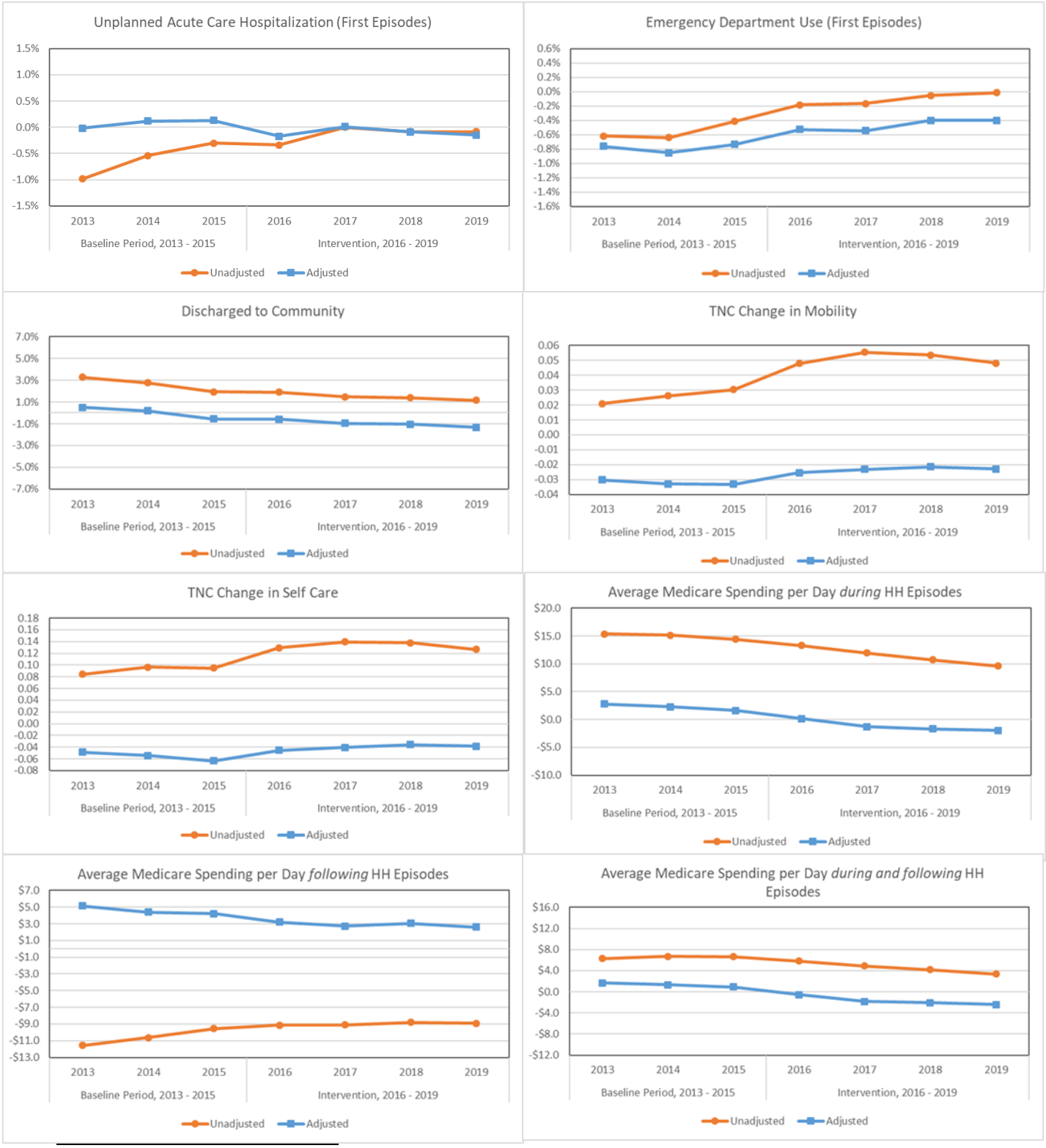
Upward or downward sloping lines during 2013 – 2015 indicate a lack of parallel trends, as differences between the HHVBP and comparison groups become larger or smaller during the baseline period. For some of the measures—such as unplanned ACH—the unadjusted line (corresponding to the model without any covariate adjustment) shows evidence of a time trend. In comparison, with covariate adjustment, the plotted lines for these measures (including unplanned ACH) show greater indication of parallel trends in the adjusted measure values, with trend lines having slopes closer to zero. Together, these plots for the eight key impact measures reinforced two facts:

1. As clearly shown by the contrast between the unadjusted and adjusted plots, covariate adjustment tended to result in improvements in both the degree of balance and parallel trends between HHVBP and non-HHVBP groups during the baseline period.

2. Overall, the plotted lines showing trends in the difference in measure values between HHVBP and non-HHVBP populations from the adjusted model (that included state fixed effects) have slopes that tend to be close to zero for some impact measures (e.g., unplanned acute hospitalizations, ED utilization) but not all measures.

Measures such as the three Medicare spending per day measures and the three OASIS measures tended to have downward slopes during the baseline period. This suggests that adjusting for state fixed effects alone is not adequate to account for non-parallel trends in the baseline period for all measures. It also reinforced the need to control for pre-HHVBP differences in trends between HHVBP and comparison states, thereby warranting a model that included both state fixed effects and state-specific linear trends along with other covariates for some impact measures, which are discussed in turn below.

Exhibit A-7. Assessing Parallel Trends for Key Impact Measures based on Unadjusted vs. Adjusted Models[6]



[6] The trend lines from the adjusted model (which includes an interaction term of the treatment indicator with each of the three levels of Ambulation and Locomotion along with other covariates and state fixed effects) are plotted on the assumption that the net effect of HHVBP on different levels of ambulation at the start of care is zero.

Falsification Test

We tested for differential changes in impact measures between the HHVBP and comparison groups between the first two years of the baseline period (i.e., 2013 – 2014) and the last year of the baseline period (i.e., 2015) as a "placebo test." That is, we applied the exact same D-in-D specification (as described above) while assigning 2013 – 2014 as the baseline period and falsely assigning 2015 as the post-intervention time period, and computed a D-in-D estimate for 2015. Such estimated effects for HHVBP for 2015 should be null since the initial HHVBP performance period did not begin until 2016. Where D-in-D estimates are not statistically different from zero, we would fail to reject the parallel trends assumption (i.e., suggesting that the impact measures moved in a parallel manner for the two groups over the baseline period).

Results of these falsification tests are summarized in the following linked exhibits: Exhibit A-8, Exhibit A-9, Exhibit A-10, Exhibit A-11, Exhibit A-12, Exhibit A-13, Exhibit A-14, Exhibit A-15, and Exhibit A-16. We report the 2013 mean value for each impact measure in the HHVBP states to facilitate interpretation of the magnitude of the estimated 2015 HHVBP effect. We also use the mean value to calculate the relative change corresponding to the D-in-D falsification estimate for each measure, by expressing the estimated effect as a percentage of the 2013 mean value. The results of these calculations are shown in the last column of each table.

We found a null effect during 2015 for the two home health utilization measures: 1) percent of FFS beneficiaries with at least one home health episode per year and 2) number of home health episodes per 1,000 FFS beneficiaries per year (Exhibit A-8). For all three health status at the start of care measures, the falsification tests showed evidence of non-parallel trends. All three measures had statistically significant estimated effects at the $p<0.05$ level and estimates ranging from 1.2% to 1.5% of the 2013 HHVBP mean value (Exhibit A-9).

The results of the falsification testing on the post-acute care alternatives within 14 days following hospital discharges generally did not show evidence of non-parallel trends during the pre-intervention period, except for SNF admissions (Exhibit A-10). The 2015 impact estimate of -0.23%, which was statistically significant (at $p<0.05$ level), corresponds to a 0.9 percent decline in the proportion of SNF admissions relative to the 2013 rate of 24.4% in HHVBP states.

Falsification tests for claims-based HHA operations measures of frontloading indicated the absence of parallel trends for all but one outcome measure of interest (Exhibit A-11). Impact estimates for 2015 were statistically significant (at $p<0.05$ level) for the 14-day therapy visit count and the two binary frontloading outcomes, which indicate a larger number of skilled nursing or therapy visits within the first week of home health care compared to the second week. For this reason, a state linear trend term was added to difference-in-differences models for these measures.

Results of falsification tests for the claims-based quality measures indicated null effects during 2015 for six measures (Exhibit A-12) with the exception of SNF Use/All FFS HH Episodes where the statistically significant D-in-D falsification estimate (at $p <0.10$ level) corresponded to -1.3 percent of the baseline average value. D-in-D falsification estimates indicated a null effect during 2015 for three rehospitalization measures and for six out of eight hospitalization measures stratified by MDC

categories. Among medical and surgical type hospitalization measure, we found evidence of a lack of parallel trends only for surgical type hospitalization measure (Exhibit A-13).

For the claims-based spending measures, we found a null effect for the two out of three claims-based spending measures. However, the average Medicare spending per day during FFS HH Episodes of Care showed evidence of non-parallel trends in the baseline period with the statistically significant D-in-D falsification estimate (-$0.83, p value < 0.1) corresponding to -0.6% of mean value for these measures in 2013 (Exhibit A-14).

Overall, there was a tendency for the falsification tests to indicate non-parallel trends for the OASIS outcome measures (Exhibit A-15). In particular, there were statistically significant estimated effects (at p<0.10 level) for three of the seven OASIS outcome quality measures, with estimates at or exceeding 1.0% of the 2013 mean value for two measures (Discharge to Community and in Management of Oral Medications; Exhibit A-15). Results of falsification tests for the HHCAHPS-based impact measures indicated null effects during 2015 for each of these five measures (Exhibit A-16).

Exhibit A-8. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on Home Health Utilization Measures

Measure	Model Estimates			D-in-D Falsification[b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D	Lower 90% CI	Upper 90% CI			
Percent of FFS Beneficiaries with at Least One HH Episode[a]						
2016	-0.25	-0.76	0.25	-0.12	10.4%	-1.1%
2017	-0.30	-0.88	0.28			
2018	-0.22	-0.81	0.37			
2019	-0.12	-0.70	0.47			
Cumulative	-0.22	-0.79	0.34			
Number of HH Episodes per 1,000 FFS Beneficiaries						
2016	-3.78	-14.82	7.26	-2.25	182.2	-1.2%
2017	-2.38	-15.77	11.01			
2018	1.07	-12.55	14.69			
2019	4.85	-8.86	18.55			
Cumulative	-0.08	-12.94	12.79			

[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. CI= Confidence Interval.

Exhibit A-9. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on FFS Claims-Based and OASIS-Based Case-Mix Measures

Measure	Model Estimates			D-in-D Falsification[a]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D	Lower 90% CI	Upper 90% CI			
HCC Score at the Start of Care						
2016	-0.01	-0.02	-0.004	0.03**	2.6	1.2%
2017	-0.04	-0.06	-0.03			
2018	-0.07	-0.09	-0.05			
2019	-0.10	-0.13	-0.07			
Cumulative	-0.05	-0.07	-0.04			
TNC Mobility at Start of Care						
2016	0.03	-0.01	0.07	0.07**	4.7	1.5%
2017	0.03	-0.05	0.10			
2018	-0.05	-0.15	0.04			
2019	-0.15	-0.28	-0.03			
Cumulative	-0.04	-0.12	0.04			
TNC Self-Care at Start of Care						
2016	0.04	-0.03	0.11	0.11**	9.3	1.2%
2017	0.01	-0.13	0.14			
2018	-0.12	-0.30	0.06			
2019	-0.28	-0.52	-0.04			
Cumulative	-0.09	-0.25	0.06			

[a] *Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05. CI= Confidence Interval.*

Exhibit A-10. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on FFS Claims-Based Measures Examining Post-Acute Care

Measure	Model Estimates			D-in-D Falsification[a, b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D[a]	Lower 90% CI[a]	Upper 90% CI[a]			
Home Health Care						
2016	-0.06	-0.25	0.13	-0.05	22.6%	-0.2%
2017	-0.03	-0.26	0.20			
2018	0.28*	0.005	0.56			
2019	0.37*	0.05	0.68			
Cumulative	0.14	-0.09	0.36			
Skilled Nursing Facility						
2016	-0.35**	-0.52	-0.17	-0.23**	24.4%	-0.9%
2017	-0.41**	-0.63	-0.20			
2018	-0.52**	-0.77	-0.27			
2019	-0.57**	-0.85	-0.29			
Cumulative	-0.46**	-0.67	-0.26			
Inpatient Rehabilitation Facility						
2016	0.08	-0.01	0.16	0.03	3.1%	1.0%
2017	0.20**	0.08	0.32			
2018	0.12	-0.01	0.26			
2019	0.11	-0.05	0.27			
Cumulative	0.13*	0.02	0.24			
Self Care						
2016	0.15	-0.11	0.42	0.14	39.2%	0.4%
2017	0.10	-0.22	0.42			
2018	-0.07	-0.43	0.30			
2019	-0.08	-0.47	0.31			
Cumulative	0.03	-0.28	0.33			
Hospital Outpatient Therapy						
2016	0.04	-0.02	0.09	0.02	2.1%	1.0%
2017	0.02	-0.05	0.09			
2018	0.02	-0.05	0.09			
2019	-0.07	-0.14	0.01			
Cumulative	0.003	-0.06	0.06			

*[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05. CI= Confidence Interval. | Regression adjustment for these D-in-D models use a standard set of covariates across all forms of post-acute care to control for observed and unobserved imbalances at baseline, including state fixed effects, quarter-year fixed effects, age, rural status, and participation in an Accountable Care Organization Advanced Alternative Payment Model.*

Exhibit A-11. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on FFS Claims-Based HHA Operations Measures

Measure	Model Estimates			D-in-D Falsification[b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D	Lower 90% CI	Upper 90% CI			
Number of Skilled Nurse Visits During First 2 Weeks						
2016	0.03*	0.003	0.06	-0.01	4.06	-0.2%
2017	0.03	-0.005	0.07			
2018	0.04	0.0002	0.09			
2019	0.07**	0.02	0.12			
Cumulative	0.04	0.01	0.08			
Number of Therapist Visits During First 2 Weeks						
2016	-0.08**	-0.12	-0.04	-0.07**	3.95	-1.8%
2017	-0.14**	-0.18	-0.09			
2018	-0.10**	-0.15	-0.05			
2019	-0.10**	-0.16	-0.04			
Cumulative	-0.10**	-0.15	-0.06			
Frontloading Skilled Nurse Visits[a]						
2016	-0.75**	-1.19	-0.30	-0.72**	62.44%	-1.2%
2017	-0.49	-1.04	0.07			
2018	-0.59	-1.21	0.03			
2019	-0.18	-0.91	0.56			
Cumulative	-0.51	-1.02	-0.01			
Frontloading Therapist Visits[a]						
2016	0.09	-0.32	0.49	-0.74**	30.71%	-2.4%
2017	-0.02	-0.51	0.47			
2018	0.30	-0.23	0.84			
2019	0.51	-0.12	1.14			
Cumulative	0.21	-0.23	0.65			

*[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05. CI=Confidence Interval.*

Exhibit A-12. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on FFS Claims-Based Utilization Outcome Measures

Measure	Model Estimates			D-in-D Falsification[a, b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D[a]	Lower 90% CI[a]	Upper 90% CI[a]			
Unplanned Acute Care Hospitalization/First FFS HH Episodes						
2016	-0.25**	-0.38	-0.11	0.06	15.3%	0.4%
2017	-0.07	-0.21	0.08			
2018	-0.17*	-0.32	-0.01			
2019	-0.22**	-0.39	-0.06			
Cumulative	-0.18**	-0.30	-0.06			
ED Use (no Hospitalization)/First FFS HH Episodes						
2016	0.26**	0.14	0.37	0.06	11.3%	0.5%
2017	0.24**	0.11	0.36			
2018	0.38**	0.25	0.51			
2019	0.38**	0.23	0.53			
Cumulative	0.31**	0.20	0.42			
ED Use followed by Inpatient Admission/First FFS HH Episodes						
2016	-0.21**	-0.34	-0.08	0.09	13.8%	0.7%
2017	-0.07	-0.21	0.07			
2018	-0.14	-0.30	0.02			
2019	-0.20*	-0.36	-0.03			
Cumulative	-0.15**	-0.27	-0.03			
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes						
2016	0.01	-0.15	0.17	0.11	25.8%	0.4%
2017	0.14	-0.04	0.33			
2018	0.24**	0.04	0.43			
2019	0.20	-0.01	0.41			
Cumulative	0.15	-0.01	0.30			
Unplanned Acute Care Hospitalization/All FFS HH Episodes						
2016	-0.18**	-0.30	-0.07	0.10	16.8%	0.6%
2017	-0.14*	-0.27	-0.01			
2018	-0.22**	-0.36	-0.08			
2019	-0.23**	-0.38	-0.07			
Cumulative	-0.19**	-0.31	-0.08			
SNF Use/All FFS HH Episodes						
2016	-0.20**	-0.26	-0.15	-0.06*	4.7%	-1.3%
2017	-0.22**	-0.28	-0.16			
2018	-0.28**	-0.35	-0.21			
2019	-0.26**	-0.34	-0.18			
Cumulative	-0.24**	-0.29	-0.19			
Mortality Rate/All FFS Home Health Episodes						
2016	-0.13**	-0.17	-0.09	-0.04	3.4%	-1.2%
2017	-0.10**	-0.15	-0.05			
2018	-0.08**	-0.12	-0.03			
2019	-0.08**	-0.14	-0.03			
Cumulative	-0.10**	-0.13	-0.06			

*[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05.*
CI= Confidence Interval. | HHVBP performance measures in italics.

Exhibit A-13. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on Causes of FFS Claims-Based Hospitalization Measures

Measure	Model Estimates			D-in-D Falsification[a, b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D[a]	Lower 90% CI[a]	Upper 90% CI[a]			
Rehospitalization (overall)						
Cumulative	-0.20*	-0.37	-0.03	0.15	19.5%	0.8%
Rehospitalization for Same MDC as Index Medical Hospitalization						
Cumulative	-0.17**	-0.27	-0.07	-0.09	6.5%	-1.4%
Rehospitalization for Different MDC as Index Medical Hospitalization						
Cumulative	-0.11	-0.27	0.06	0.04	16.6%	0.3%
Unplanned Acute Care Hospitalization with Circulatory System Diagnosis/First FFS HH Episodes						
Cumulative	-0.03	-0.08	0.01	0.05	3.5%	1.5%
Unplanned Acute Care Hospitalization with Musculoskeletal System Diagnosis/First FFS HH Episodes						
Cumulative	0.01	-0.02	0.03	0.04*	1.4%	2.7%
Unplanned Acute Care Hospitalization with Digestive System Diagnosis/First FFS HH Episodes						
Cumulative	-0.03**	-0.06	-0.01	0.02	1.6%	0.9%
Unplanned Acute Care Hospitalization with Kidney and Urinary Tract Diagnosis/First FFS HH Episodes						
Cumulative	-0.04**	-0.07	-0.02	-0.02	1.5%	-1.6%
Unplanned Acute Care Hospitalization Respiratory System Diagnosis/First FFS HH Episodes						
Cumulative	-0.02	-0.05	0.01	-0.02	2.5%	-0.7%
Unplanned Acute Care Hospitalization Nervous System Diagnosis/First FFS HH Episodes						
Cumulative	-0.03**	-0.05	-0.005	-0.02	1.1%	-1.6%
Unplanned Acute Care Hospitalization with Infectious and Parasitic Diagnosis/First FFS HH Episodes						
Cumulative	-0.06**	-0.09	-0.03	-0.06**	1.2%	-4.7%
Unplanned Acute Care Hospitalization with Other Major Diagnostic Categories/First FFS HH Episodes						
Cumulative	0.02	-0.02	0.07	0.05*	3.1%	1.7%
Medical Type Unplanned Acute Hospitalization/First FFS HH Episodes						
Cumulative	-0.19**	-0.30	-0.08	-0.03	13.0%	-0.3%
Surgical Type Unplanned Acute Hospitalization/First FFS HH Episodes						
Cumulative	0.003	-0.03	0.04	0.06**	2.6%	2.4%

*[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05. CI=Confidence Interval. | Consistent with the analyses in the main summary report only cumulative estimates are presented.*

Exhibit A-14. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on FFS Claims-Based Spending Measures

Measure	Model Estimates			D-in-D Falsification[a]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D	Lower 90% CI	Upper 90% CI			
Average Medicare Spending per Day during and following FFS HH Episodes of Care						
2016	-$1.87**	-$2.45	-$1.28	-$0.55	$135.41	-0.4%
2017	-$3.13**	-$3.84	-$2.43			
2018	-$3.36**	-$4.14	-$2.58			
2019	-$3.74**	-$4.62	-$2.87			
Cumulative	-$2.99**	-$3.62	-$2.37			
Average Medicare Spending per Day during FFS HH Episodes of Care						
2016	-$2.07**	-$2.81	-$1.33	-$0.83*	$148.31	-0.6%
2017	-$3.50**	-$4.35	-$2.65			
2018	-$3.90**	-$4.87	-$2.93			
2019	-$4.21**	-$5.32	-$3.10			
Cumulative	-$3.38**	-$4.19	-$2.58			
Average Medicare Spending per Day following FFS HH Episodes of Care						
2016	-$1.34**	-$2.20	-$0.49	-$0.65	$102.03	-0.6%
2017	-$1.86**	-$2.83	-$0.90			
2018	-$1.55**	-$2.61	-$0.49			
2019	-$1.96**	-$3.11	-$0.80			
Cumulative	-$1.67**	-$2.50	-$0.84			

[a] *Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05. CI= Confidence Interval.*

Exhibit A-15. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on OASIS-Based Outcome Quality Measures

Measure	Model Estimates			D-in-D Falsification[b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D	Lower 90% CI	Upper 90% CI			
Discharged to Community[a]						
2016	-0.61**	-0.87	-0.34	-0.83**	73.0%	-1.1%
2017	-0.99**	-1.31	-0.66			
2018	-1.08**	-1.45	-0.71			
2019	-1.36**	-1.75	-0.97			
Cumulative	-1.02**	-1.32	-0.71			
Total Normalized Composite (TNC) Change in Self-Care						
2016	0.01	-0.004	0.02	-0.01	1.29	-0.8%
2017	0.02	-0.001	0.03			
2018	0.02*	0.002	0.04			
2019	0.02	-0.003	0.04			
Cumulative	0.02*	0.001	0.03			
Total Normalized Composite (TNC) Change in Mobility						
2016	0.01**	0.002	0.01	0.0003	0.39	0.1%
2017	0.01**	0.003	0.02			
2018	0.01**	0.004	0.02			
2019	0.01**	0.001	0.02			
Cumulative	0.01**	0.004	0.01			
Improvement in Dyspnea[a]						
2016	1.28**	0.69	1.88	0.51	64.5%	0.8%
2017	1.43**	0.72	2.15			
2018	0.96**	0.29	1.64			
2019	0.72*	0.03	1.41			
Cumulative	1.08**	0.50	1.67			
Improvement in Management of Oral Medications[a]						
2016	2.48**	1.71	3.24	0.66*	48.8%	1.4%
2017	3.90**	2.97	4.83			
2018	4.31**	3.37	5.26			
2019	4.05**	2.96	5.14			
Cumulative	3.74**	2.91	4.57			
Improvement in Pain Interfering with Activity[a]						
2016	0.20	-0.37	0.77	-0.50*	70.4%	-0.7%
2017	0.18	-0.51	0.88			
2018	-0.13	-0.87	0.60			
2019	-0.12	-0.83	0.60			
Cumulative	0.02	-0.58	0.63			
Improvement in Status of Surgical Wounds[a]						
2016	-0.12	-0.48	0.24	-0.28	90.2%	-0.3%
2017	0.15	-0.34	0.65			
2018	0.12	-0.46	0.71			
2019	-0.02	-0.60	0.56			
Cumulative	0.04	-0.40	0.47			

*[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. *p<0.10, **p<0.05.*
CI= Confidence Interval. | HHVBP performance measures in italics.

Exhibit A-16. Results of Falsification Tests for Assessing the Impact of the HHVBP Model on HHCAHPS-Based Patient Experience Measures

Measure	Model Estimates			D-in-D Falsification[a, b]	Average Value in HHVBP States, 2013	Estimated Effect of Falsification Findings as % of 2013 Mean
	D-in-D[a]	Lower 90% CI[a]	Upper 90% CI[a]			
How often the home health team gave care in a professional way (Professional Care)						
2016	-0.11	-0.34	0.12	-0.06	89.0%	-0.1%
2017	0.02	-0.24	0.28			
2018	-0.08	-0.33	0.18			
2019	-0.40**	-0.68	-0.13			
Cumulative	-0.14	-0.32	0.04			
How well did the home health team communicate with patients (Communication)						
2016	-0.22	-0.49	0.04	-0.23	86.2%	-0.3%
2017	-0.05	-0.34	0.24			
2018	-0.30	-0.60	0.00			
2019	-0.41**	-0.72	-0.09			
Cumulative	-0.24*	-0.46	-0.03			
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)						
2016	-0.35*	-0.66	-0.04	0.23	82.9%	0.3%
2017	0.21	-0.11	0.53			
2018	-0.24	-0.59	0.10			
2019	-0.63**	-1.00	-0.26			
Cumulative	-0.25*	-0.49	-0.01			
How do patients rate the overall care from the home health agency (Overall Care)						
2016	-0.10	-0.48	0.29	-0.15	84.6%	-0.2%
2017	0.03	-0.36	0.42			
2018	0.25	-0.15	0.65			
2019	-0.18	-0.61	0.25			
Cumulative	0.002	-0.29	0.29			
Would patients recommend the home health agency to friends and family (Likely to Recommend)						
2016	0.01	-0.43	0.46	-0.29	79.8%	-0.4%
2017	0.30	-0.16	0.76			
2018	0.40	-0.10	0.90			
2019	-0.03	-0.53	0.47			
Cumulative	0.17	-0.17	0.52			

[a] Values represent percentage point changes. [b] Represents the estimated effect of HHVBP in 2015. p<0.10, **p<0.05.*
CI= Confidence Interval. | HHVBP performance measures in italics.

The validity of inferences that are based on the D-in-D estimator will depend on whether the assumption of parallel trends between the treatment and comparison groups during the baseline period is satisfied. If baseline trends for the two groups were not found to be parallel, the comparison group would not provide a strong counterfactual for what would have been observed in the post-implementation period in the absence of HHVBP. Instead, the D-in-D estimator would, in part, capture the effects of any pre-existing differential trends between the two groups, where those trends would have otherwise continued in the post-implementation period. This would lead D-in-D estimates to either overestimate or underestimate the true effects of the treatment. Since our falsification tests rejected the null hypothesis of no difference in baseline trends between HHVBP and non-HHVBP states for certain impact measures of interest (i.e., FFS Claims-based and OASIS-based case-mix measures, FFS claims-based measures examining post-acute care, FFS Claims-Based HHA operations measures, FFS claims-based spending measures and the OASIS-based outcome quality measures), we explored alternative model specifications for estimating the effects of HHVBP on these impact measures. As described below, for the impact measures that failed to pass the falsification test with a model specification that adjusted for a set of covariates and state fixed effects, we also adjusted for state-specific linear trends to account for any non-parallel linear trends in the baseline period between the states.

A.1.5.3 Incorporating State-Specific Linear Time Trends to Account for Non-Parallel Trends during the Baseline Period

Given our findings of non-parallel trends in certain impact measures during the baseline period, we conducted regression analyses using an alternative D-in-D model that incorporated state-specific linear time trends. We added linear time trends interacted with each state indicator along with state fixed effects to the covariate list discussed above in Section A.1.4, which can be used to account for different linear trends during the baseline period between the states. We included data for all the years (2013 – 2019) to obtain the individual yearly HHVBP estimates in the post-implementation period, i.e. D-in-D estimates for 2016, 2017, 2018 and 2019.

Defining each episode *i* in time *t*, identifying the treatment episodes with an indicator variable $Treat_i$, identifying the post-implementation year variables *t* with an indicator variable $I(t = t_k)$, and identifying a vector of covariates as $\mathbf{P}_{Cov}$ (defined in Section A.1.4), the D-in-D estimator for outcome *Y* that included state-specific linear time trends was implemented as:

$$Y_{i,t} = \alpha_0 + \alpha_1 Treat_i + \sum_{k=1}^{k=4} \beta_k I(t = t_k) + \sum_{k=1}^{k=4} \delta_k Treat_i * I(t = t_k) + \sum_{j=1}^{j=3} \rho_j I(q = j) + \sum_{s=3}^{s=50} \theta_s I(S = s) + \sum_{s=1}^{s=50} \gamma_s time * I(S = s) + \omega \mathrm{P}_{Cov} + \epsilon_{i,t}$$

Where *k* goes from 1 to 4 for years 2016 -2019.

- $Treat_i$: 1, 0 indicator (1= HHVBP states, 0= Non-HHVBP states)
- $I(t = t_1)$: 1 , 0 indicator (1 when year = 2016, 0 otherwise)
- $I(t = t_2)$: 1 , 0 indicator (1 when year = 2017, 0 otherwise)
- $I(t = t_3)$: 1 , 0 indicator (1 when year = 2018, 0 otherwise)
- $I(t = t_4)$: 1 , 0 indicator (1 when year = 2019, 0 otherwise)

- α_0 is an intercept
- α_1 is the average difference between the HHVBP and comparison populations over the pre-implementation period
- α_0 is an intercept
- α_1 is the average difference between the HHVBP and comparison populations over the pre-implementation period
- β_k is the average change from pre- to post-implementation for the HHVBP population, where *k* = 1 for year 2016, *k* = 2 for year 2017, *k* = 3 for year 2018, k = 4 for year 2019
- δ_k is the yearly D-in-D effect, for *k* = 1, 2, 3, 4; the difference in the change from pre-implementation to post-implementation for the HHVBP population relative to the comparison population (i.e., to estimate the treatment effect of HHVBP) from a model that adjusts for state fixed effects and state-specific linear trends
- ρ_j coefficients capture seasonal effects associated with the four quarters of the year, where *j* = 1, 2, 3 (one quarter omitted as reference)
- $I(S = s)$: 1, 0 indicator (1 when from state *s*, 0 otherwise); two states omitted as reference since "treat" is also included in the model
- θ_s coefficients are fixed effects for each state *s*
- $time$: linear term ranging from 2013-2019
- γ_s: coefficients associated with state-specific linear trends, time trends for each state interacted with fixed effects indicator for each state *s*
- ω is a vector of coefficients associated with the vector of covariates $\mathbf{P}_{Cov}$
- $\epsilon_{i,t}$ episode-specific error term.

With this model, the D-in-D estimator measures the difference in the deviations from the average of the state trend lines between the HHVBP and comparison groups in the post-HHVBP period, while accounting for any non-parallel linear trends in the baseline period between the states.

In the regression equation, we included three estimates (ρ_1, ρ_2, ρ_3) capturing quarterly effects since we included a constant in the equation. Each episode was given an equal weight except for the four average Medicare spending per day measures, which were weighted by the number of days included in the denominator (see Section A.2.2). As with our primary D-in-D model specification, standard errors were clustered at the agency level (see Section A.1.4.1). In order to obtain the average annual (cumulative) impact estimate over the four HHVBP Model years (i.e., 2016 – 2019), we calculated a linear combination of the four year-specific impact estimates with each year's impact weighted by the number of episodes in that year, or in the case of the spending measures, weighted by the sum of denominator days in all states for the year. As explained in Section A.1.5.1, we also estimated a linear combination of the post-implementation years to obtain an average annual D-in-D impact estimate for models that included state-specific linear trends.

Exhibit A-17 shows a side-by-side comparison of the cumulative D-in-D estimates obtained from two alternative D-in-D models for the measure sets where there was a pattern of non-parallel trends for some of the individual measures. The first column reports estimates based on the D-in-D model specified in Section A.1.5.1, followed by the falsification results corresponding to the same model specification (these results are identical to those presented in Exhibit A-12, Exhibit A-14 and Exhibit A-15

above). The last column presents estimates from the D-in-D model that incorporates state-specific linear trends.

Broadly, results from the D-in-D model that adjusts for state-specific linear time trends along with state fixed effects (i.e., in the last column) are in the direction we would expect based on a combination of results from the primary D-in-D model (i.e., in the first column of results) and the falsification test (i.e., in the second column). For example, the inclusion of state-specific linear time trends results in a smaller but still statistically significant reduction in the measure of total Medicare spending during and following home health care when accounting for the relative decline already occurring in HHVBP states in the pre-HHVBP period (i.e., D-in-D estimates of $1.76 vs. $2.99). Similarly, the inclusion of linear trends by state resulted in a smaller but still statistically significant improvement in management of oral medications when accounting for the relative improvement already occurring in HHVBP states in the pre-HHVBP period (i.e., D-in-D estimates of 2.77 vs. 3.74 percentage points). The D-in-D estimates for SNF Use/All FFS HH Episodes were statistically significant for both the models and very similar in magnitude (-0.24 vs -0.19 percentage points).

Exhibit A-17. Comparison of Cumulative D-in-D Estimates between Models with and without State-Specific Linear Time Trends

Measures	D-in-D Estimate[a]	Falsification[b]	D-in-D Estimate with State- Specific Linear Time Trend[a]
FFS Claims-Based Utilization Measures			
SNF Use/All FFS HH Episodes[c]	-0.24**	-0.06*	-0.19**
FFS Claims-Based Spending Measures			
Average Medicare Spending per Day among FFS HH beneficiaries during and following HH Episodes of Care	-$2.99**	-$0.55	-$1.76**
Average Medicare Spending per Day among FFS HH beneficiaries during HH Episodes of Care	-$3.38**	-$0.83**	-$1.46*
Average Medicare Spending per Day among FFS HH beneficiaries following HH Episodes of Care	-$1.67**	-$0.65	$-0.01
OASIS Outcome Impact Measures			
Discharged to Community[c]	-1.02**	-0.83**	0.78**
Total Normalized Composite Change in Mobility	0.01**	0.0003	0.01**
Total Normalized Composite Change in Self-Care	0.02*	-0.01	0.04**
Improvement in Dyspnea[c]	1.08**	0.51	0.32
Improvement in Management of Oral Medications[c]	3.74**	0.66*	2.77**
Improvement in Pain Interfering with Activity[c]	0.02	-0.50*	1.86**
Improvement in Status of Surgical Wounds[c]	0.04	-0.28	0.63

*[a] Cumulative estimates for 2016-19 combined. | [b] Represents the estimated effect of HHVBP in 2015. | [c] Represents percentage point changes. * p<0.10, **p<0.05. | HHVBP performance measures in italics.*

Although incorporating state-specific linear time trends in our D-in-D model allows us to account for non-parallel trends in the baseline period between the HHVBP and comparison groups for certain impact measures, it assumes that the average difference in slopes between the HHVBP state trends and

the comparison state trends observed in the baseline period would have continued to change at the same rate in the absence of HHVBP. This will be an increasingly strong assumption to make throughout the course of this eight-year evaluation.

Consistent with our approach that was implemented in the Third Annual Report, we therefore incorporated state-specific linear time trends for the following measure sets that failed the falsification test: FFS Claims-based and OASIS-based **case-mix measures**, FFS claims-based **measures examining post-acute care**, FFS Claims-Based **HHA operations measures**, FFS claims-based **spending measures** and the **OASIS-based outcome** quality measures (Exhibit A-9, Exhibit A-10, Exhibit A-11, Exhibit A-13, and Exhibit A-14 respectively). Though not all measures in each of the measure sets rejected the null hypothesis of parallel trends in the baseline period (for example, three out of seven OASIS outcome measures, three out of four HHA operations measures) we used state-specific linear time trends for all measures within these measure sets. In contrast, only one of nine utilization/causes of hospitalization measures (SNF Use/ All FFS HH episodes) failed falsification with state fixed effects at 0.1 level of significance but as noted in Exhibit A-17, the D-in-D estimates of SNF Use measure were very similar between a model that adjusted for state linear trends vs. not (-0.19 vs.-0.24) and hence we used state-fixed effects for all FFS claims based utilization measures. This was done to facilitate interpretation of results among strongly related impact measures and to maintain a uniform analytic approach where possible. Similarly, for home health utilization measures, causes of hospitalization and HHCAHPS-based quality measures we employed the simpler D-in-D model specification discussed in Section A.1.5.1 given the findings for the falsification test for these measures (Exhibit A-8 and Exhibit A-16).

Exhibit A-18 provides at-a-glance a summary of the risk- factors that are adjusted for in the multivariable regression model. For details please refer to section A.1.3.1.

Exhibit A-18. Summarizing Model Specifications for All the Impact Measures Used To Evaluate the HHVBP Model

Measure	List of covariates included in multivariable D-in-D model	Additional adjusters
HHA Total Performance Score (TPS)* (Section 5)		
Home Health Utilization Measures (Section 3)		
Percent of FFS Beneficiaries with at Least One HH Episode	None	State fixed effects
Number of HH Episodes per 1,000 FFS Beneficiaries		
FFS Claims-Based and OASIS-Based Case-Mix Measures (Section 3)		
HCC Score at the Start of Care	Agency characteristics listed in Exhibit A-3	State fixed effects + State Linear Trends
Total Normalized Composite (TNC) Mobility at Start of Care		
Total Normalized Composite (TNC) Self-Care at Start of Care		
FFS Claims-Based Measures Examining Post-Acute Care (Section 3)		
Home Health Care	Subset of factors listed in Exhibit A-3	State fixed effects+ State Linear Trends
Skilled Nursing Facility		
Inpatient Rehabilitation Facility		
Hospital Outpatient Therapy		
None (i.e., Self-Care)		
FFS Claims-Based HHA Operations Measures (Section 4)		
Number of Skilled Nurse Visits During First 2 Weeks	Exhibit A-3, Exhibit A-4+ Medicare Entitlement indicator + Count of ED visits	State fixed effects + State Linear Trends
Number of Therapy Visits During First 2 Weeks		
Frontloading Skilled Nurse Visits		
Frontloading Therapy Visits		
FFS Claims-Based Utilization Measures (Section 6)		
Unplanned Acute Care Hospitalization/First FFS HH Episodes	Exhibit A-3, Exhibit A-4+ Medicare Entitlement indicator	State fixed effects
Outpatient ED Use (No Hospitalization)/First FFS HH Episodes		
ED Use Followed by Inpatient Admission/First FFS HH Episodes		
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes		
Unplanned Acute Care Hospitalization/All FFS HH Episodes		
Skilled Nursing Facility (SNF) Use/All FFS HH Episodes		
Causes of FFS Claims-Based Hospitalization Measures□ (Section 6)		
Rehospitalization (Overall)	Exhibit A-3, Exhibit A-4+ Medicare Entitlement indicator	State fixed effects
Rehospitalization for Same MDC as Index Medical Hospitalization		
Rehospitalization for Different MDC as Index Medical Hospitalization		
FFS Claims-Based Spending Measures‡ (Section 7)		
Average Medicare Spending per Day during/following FFS HH Episodes of Care	Exhibit A-3, Exhibit A-4+Medicare Entitlement indicator	State fixed effects + State Linear Trends
Average Medicare Spending per Day during FFS HH Episodes of Care		
Average Medicare Spending per Day following FFS HH Episodes of Care		
OASIS-Based Outcome Quality Measures (Section 8)		
Discharged to Community	Exhibit A.3 + Medicaid Indicator + Start of Care values for the respective measures (as applicable)	State fixed effects + State Linear Trends
Total Normalized Composite (TNC) Change in Self-Care		
Total Normalized Composite (TNC) Change in Mobility		
Improvement in Dyspnea		
Improvement in Management of Oral Medications		
Improvement in Pain Interfering with Activity		
Improvement in Status of Surgical Wounds		
FFS Claims-Based Quality Measure (Section 8)		

Measure	List of covariates included in multivariable D-in-D model	Additional adjusters
Mortality Rate/All FFS Home Health Episodes	Exhibit A-3, Exhibit A-4+ Medicare Entitlement indicator	State fixed effects
HHCAHPS-Based Patient Experience Measures (Section 9)		
How often the home health team gave care in a professional way (Professional Care)	Subset of factors listed in Exhibit A-3 aggregated to the agency level	State fixed effects
How well did the home health team communicate with patients (Communication)		
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)		
How do patients rate the overall care from the home health agency (Overall Care)		
Would patients recommend the home health agency to friends and family (Likely to Recommend)		

*Section numbers refer to corresponding sections in the main summary report. HHVBP Measures indicated by italic text. |As discussed in Section 1.2, in 2019 CMS removed all OASIS process measures and replaced three of the OASIS outcome measures with the two composite measures (see Exhibit 2). | We do not include the three measures that are self-reported by HHAs since these are only available for HHAs in the HHVBP states. | All measures have a baseline period of 2013-2015 except for HHA Total Performance Score which has a baseline period of 2015./ *As discussed in Section 2.2.2, a D-in-D approach is not used for analysis of agency TPS. ▪We also analyzed hospitalization measure stratified by eight MDC categories and by surgical versus medical types.| ‡For each of the three spending measures, we analyze their components: Medicare Part B carrier/DME combined, HH, Hospice, Inpatient, Outpatient ED and Observation Stays, other Outpatient/Outpatient types combined, and SNF*

Addition of state linear trends, however, leads to a reduction in the level of precision of the annual D-in-D estimates as we incorporate additional years of data into the analyses (Angrist 2015)[7]. Consequently, it may affect the statistical significance of the cumulative estimate, which is a weighted average of the yearly D-in-D estimates. This underscores the importance of checking the practical significance of impact estimates in addition to their statistical significance. It is also possible for there to be residual non-linear, non-parallel trends based on a model that adjusts for state fixed effects and state-specific linear trends. We will continue to analyze the influence of such potential deviations from model assumptions on impact estimates throughout the course of this evaluation.

A.1.6 Comparison Group for State-Level Analyses

For the state-specific analyses presented in this report, the choice of an appropriate comparison group for each HHVBP state was largely driven by the extent of balance that exists between the treatment and comparison groups on factors that can potentially impact outcomes of interest. Achieving this balance and reducing observed differences in the two populations was important as it would otherwise lead us to erroneously infer an effect of HHVBP that was actually a result of differences in the underlying populations. Leveraging the design of the model, the regional groups from which CMS randomly selected the HHVBP states, were used as comparison groups for each state as listed below (Exhibit A-19). As specified in the CY 2016 Final Rule,[8] each regional grouping included states that were similar in utilization, demographics, and clinical characteristics while being geographically located in close proximity to one another. Another motivation for choosing the regional groups as comparison groups

[7] Angrist, J.D., & Pischke, J.S. (2015). *Mastering 'metrics: The path from cause to effect*.
[8] See 2015 Final Rule here.

was that collectively they constituted all the 41 non-HHVBP states which would help us to reconcile the national level results with the state-specific results.

Exhibit A-19. HHVBP States and their Corresponding Regional Group

HHVBP State	Non-HHVBP States in Regional Group
Arizona (AZ)	New Mexico, California, Nevada, Utah, Colorado
Florida (FL)	Texas, Oklahoma, Louisiana, Mississippi
Iowa (IA)	North Dakota, South Dakota, Montana, Wisconsin, Minnesota
Massachusetts (MA)	Vermont, Maine, Connecticut, Rhode Island, New Hampshire
Maryland (MD)	Delaware, New Jersey, Pennsylvania, New York
North Carolina (NC)	Alabama, Georgia, South Carolina, Virginia
Nebraska (NE)	Ohio, West Virginia, Indiana, Missouri, Kansas
Tennessee (TN)	Illinois, Kentucky, Arkansas, Michigan
Washington (WA)	Oregon, Alaska, Hawaii, Wyoming, Idaho

Based on our assessment of the degree of balance among a wide range of the characteristics of each HHVBP state and the regional grouping from which it was selected, and a goal of maintaining uniformity with the approach we use for our national-level analyses, we adopted a similar comparison group approach for individual states.

As explained in the Third Annual Report, most of the covariates and the priority measures exhibited a reasonably strong degree of balance between each HHVBP state and its corresponding regional grouping. The factors that demonstrated less balance at the state level also tended to show less balance at the national level (e.g. beneficiary race/ ethnicity, agency for-profit, non-profit, or government ownership, hospital or freestanding setting, chain status, and agency size). As we did for our analyses of the impact of HHVBP at the national level, we used multivariate regression to achieve balance on those factors that remained imperfectly balanced between each HHVBP state and its respective comparison group.

As noted in the Third Annual Report, we assessed the validity of the comparison group by testing the assumption of parallel baseline trends in impact measures between the HHVBP states and their respective regional comparison groups. The tests concluded that using a regional group as the comparison group for each of the nine HHVBP states helped to achieve an overall pattern of reasonably similar baseline trends for many of the impact measures of interest for this evaluation. At the national level, for impact measures that exhibited a lack of parallel trends during the baseline period, we incorporated state-specific linear time trends (Section A.1.5.3 and Exhibit A-18). Similarly at the state level, for impact measures exhibiting a lack of parallel trends during the baseline period, we incorporated state-specific linear time trends for their respective measure sets. At the state level, these measure sets were FFS claims-based and OASIS-based case-mix measures, FFS claims-based utilization measures, FFS claims-based Medicare spending measures, OASIS-based outcome measures.

A.1.7 Analytic Approach for Agency Total Performance Scores

As a metric that combines agency performance on the range of quality measures included in HHVBP and used to determine Medicare payment adjustments for HHAs in the HHVBP states, the TPS represents a broad measure of agency performance that is incentivized under HHVBP. As such, the TPS is of interest

as an overall performance indicator for comparison between agencies in model states with those in non-model states where this metric does not affect Medicare payments to HHAs.

Given the considerations discussed in this section, we examined the impact of the HHVBP Model on overall agency performance by comparing TPS values in model states with those in non-model states. We used multivariate linear regression to examine agency TPS in each year from 2016 – 2019 while accounting for differences in certain characteristics of HHAs between HHVBP and non-HHVBP states. These factors included agency size, chain status, ownership type, age, and freestanding versus hospital-based, as well as indicators of patient demographic characteristics and insurance.

As discussed above, our primary analytic approach for this evaluation involves a D-in-D methodology, where we test for differential changes from the baseline period to the post-HHVBP period in the model group relative to the comparison group. A D-in-D approach to examining TPS values, however, is not optimal over the duration of this evaluation and was not used. A key consideration is that the methodology for computing TPS is expected to change over time. For example, one of the initial performance measures, the Drug Education on All Medications Provided to Patient/Caregiver during All Episodes of Care, was removed from the HHVBP measure set starting in the third performance year of the model (2018) since many HHAs were found to be achieving full performance on this measure.[9] Further changes to both the HHVBP measure set and to the measure weights took effect in 2019, the fourth performance year of the model.[10] One effect of such changes in methodology is that TPS values from different payment years are less comparable, as changes in TPS across payment years may in part reflect changes in the components of the TPS rather than necessarily changes in agency performance.

In addition, the TPS already captures changes over time in performance. For each HHA, the TPS is calculated by summing the applicable measure scores. For each measure, the performance of individual HHAs is measured based on a combination of (a) their levels of achievement on the measure relative to their state cohort's performance during the baseline period and (b) their improvement over time relative to their own previous performance levels. For each measure, agencies receive the higher of their achievement score or their improvement score. However, regardless of which score is higher for a specific measure, the average score that results among HHAs in a state represents a measure of improvement in performance relative to that observed in a prior period—whether to that of the overall state cohort or of those particular HHAs. As a result, the TPS calculation inherently captures changes over time in performance, which are reflected in the results of a cross-sectional regression analysis.

As a test of whether the HHA measure scores (which comprise the TPS) reflect improvement relative to an HHA's own baseline as well as its state cohort's baseline, we examined correlations between average measure scores among HHAs in each state and each of the following:

- The average difference between the measure rate for each HHA during the performance period and its state-level achievement threshold.[11]
- The average difference between the measure rate for each HHA during the performance period and its own baseline performance measure rate.

[9] See 2017 Final Rule here.
[10] See 2018 Final Rule here.
[11] See 2015 Final Rule here.

Among the individual performance measures, we generally found correlations of between 0.6 and 0.9 for both types of correlations above.[12] These results indicate that average HHA measure scores in a state have a moderately strong correlation with *both* (a) the amount by which average HHA performance levels in a given performance year exceed their state cohort's baseline performance and (b) the extent of improvement in average HHA performance over baseline performance. That is, in the aggregate, higher measure scores tended to indicate greater improvement in HHA performance relative to both the state cohort's baseline performance and to an HHA's own baseline performance.

A limitation of comparing TPS across states is that each agency's achievement on a measure is determined relative to the baseline performance for that agency's specific state cohort. The achievement thresholds and benchmarks that were used to determine agency achievement scores were calculated separately for each state. HHA achievement scores are therefore calculated relative to baseline performance levels that can vary across states. Large differences across states in baseline performance levels used to calculate measure scores could theoretically have implications for comparisons of measure scores and, in turn, TPS across states or groups of states. Therefore, we examined relative performance in HHVBP and non-HHVBP states to rule out the possibility of higher average achievement scores among agencies in HHVBP states being due to a lower baseline level of performance among agencies in those states. This scenario would indicate greater room for improvement at the time the HHVBP Model was implemented. Below, we examined (and rejected) the possibility that differences in baseline performance levels between agencies in HHVBP and non-HHVBP states might have implications for comparisons of TPS between these groups.

For each HHVBP measure, we examined achievement thresholds and benchmarks among agencies in HHVBP states relative to non-HHVBP states in 2019 (Exhibit A-20).[13] For HHVBP measures that reflect indicators of utilization based on Medicare claims (i.e., ACH and ED visits), indicators of care processes based on OASIS data, and indicators of patient satisfaction based on HHCAHPS data, average achievement thresholds and average benchmarks were within one half of one percentage point. For example, during 2019, the average achievement threshold for the unplanned ACH measure was 15.8 percent among agencies in HHVBP states and 15.6 percent among those in non-model states.

[12] See Section C.3 in our Third Annual Report Technical Appendix here.
[13] Achievement threshold is defined as the median measure value for all HHAs in the state during the baseline period, and the benchmark is defined as the mean measure value for the best performing decile of all HHAs in the state during the baseline period. See 2015 Final Rule here.

Exhibit A-20. Average Measure Achievement Thresholds and Benchmarks, HHVBP Performance Year 2019

HHVBP Performance Measure	Average Achievement Threshold		Average Benchmark	
	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP
ED Use (no Hospitalization)/First FFS Home Health Episodes	11.8%	12.3%	6.1%	5.9%
Unplanned ACH/First FFS Home Health Episodes	15.8%	15.6%	8.9%	8.7%
Discharged to Community	71.0%	69.3%	83.7%	85.3%
Improvement in Management of Oral Medications	54.0%	51.6%	74.6%	75.9%
Improvement in Dyspnea	69.5%	63.8%	88.0%	87.3%
Improvement in Pain Interfering with Activity	71.5%	66.3%	91.0%	90.9%
TNC Change in Self-Care	1.709	1.565	2.158	2.161
TNC Change in Mobility	0.607	0.554	0.768	0.767
How often the home health team gave care in a professional way	89.0%	88.9%	94.2%	94.0%
How well did the home health team communicate with patients	86.3%	85.8%	91.9%	92.3%
Did the home health team discuss medicines, pain, and home safety with patients	83.7%	83.9%	90.3%	91.6%
How do patients rate the overall care from the home health agency	84.7%	84.9%	93.0%	93.2%
Would patients recommend the home health agency to friends and family	80.1%	79.6%	90.5%	90.5%

For the OASIS-based measures of patient outcomes, differences between the two groups in the average achievement thresholds typically ranged between two and five percentage points, with higher thresholds for the HHVBP group. This included the three outcome improvement measures and the discharge to community measure. For example, the average achievement threshold for the measure of improvements in management of oral medications was 54.0 percent among HHAs in HHVBP states and 51.6 percent among those in non-model states. Differences in the average benchmarks were smaller, generally within one percentage point. For the two TNC measures, differences between the two groups in the average achievement thresholds ranged between 0.05 and 0.14 points, with higher thresholds for the HHVBP group. Average benchmarks are very close between HHVBP and Non-HHVBP group for them.

Average agency achievement thresholds and benchmarks among agencies in HHVBP and non-HHVBP states were virtually identical for the three previous performance years, since they used the same baseline year (2015) as performance year 2019.[14] These comparisons do not suggest systematic, large differences between the HHVBP and non-HHVBP groups in baseline performance levels when comparing HHA measure scores and TPS values.

[14] See Section C.3 in our Third Annual Report Technical Appendix here.

A.2 Variable and Impact Measure Definitions

Below, we describe how we specified and defined descriptive variables and impact measures that were used in this Annual Report.

A.2.1 Descriptive Variables

A.2.1.1 Beneficiary Characteristics

Total Number of Beneficiaries Receiving Home Health Care. Home health claims and OASIS episodes of care were used to identify and count the number of unique home health beneficiaries with at least one home health claim or OASIS episode of care in a specified time period.

Age. Age was calculated based on the floored (i.e., rounding down to nearest integer) year difference between patient birth date on the OASIS assessment and the OASIS assessment effective date; if the OASIS information was missing, then age was calculated based on the floored year difference between patient date of birth and the claims-based episode start date.

Gender. Gender indicator was primarily derived from the OASIS assessment item M0069; if the OASIS information was missing, then gender was derived from the variable SEX_IDENT_CD in the Master Beneficiary Summary File (MBSF) Base segment data file.

Race/Ethnicity. Race indicators (white, black, Hispanic, other race) came from OASIS assessment item M0140; American Indian or Alaska Native, Asian and Native Hawaiian or Pacific Islander are grouped into the "other" race category. The OASIS item allows for selection of more than one race; therefore, a patient could have multiple race flags indicated. If the OASIS information was missing, then RTI_RACE_CD from the MBSF Base segment data were used to calculate race indicators. We recoded race categories to mutually exclusive groups using the following rules:

- Hispanic (regardless of black/white/other race)
- Black (as the only race indicated; will be non-Hispanic)
- White (as the only race indicated; will be non-Hispanic)
- Other (as the only race indicated; will be non-Hispanic)
- Multiracial (combination of black/white/other race; will be non-Hispanic)

Dual Eligible. For the month that a given claim-based episode starts or an OASIS-based episode of care ends, dual status indicators were evaluated in the MBSF. If the beneficiary was in the MBSF Base segment data and had Dual Status code value in ('01','02','03','04','05','06','08'), then their Dual flag was set to 1 for that episode. Otherwise, if they did not have enrollment data for that month in the MBSF or if the Dual Status code was not in ('01','02','03','04','05','06','08'), then their Dual flag was set to 0.

Medicaid Only (either Health Maintenance Organization [HMO] or FFS without dual). For OASIS episodes of care, beneficiaries were marked as Medicaid Only, if they were not dual eligible, as defined via MBSF, and OASIS item M0150 ('Current Payment Sources for Home Care') indicated either '3 - Medicaid (traditional fee-for-service)' or '4 - Medicaid (HMO/managed care).'

Rural/Urban. County Core-Based Statistical Area (CBSA) codes from the Area Health Resource File (AHRF) data were used to identify rural counties (i.e., those that lacked a CBSA code) and urban counties (i.e., those with a CBSA code). Rural/urban indicators were then matched to beneficiaries' county information as derived from the ZIP code reported on the OASIS assessment form. If ZIP code was not

available from the OASIS assessment, then the county where home health services were provided was derived based on a hierarchy of data sources: CBSA code reported on the home health claim, beneficiary ZIP code from OASIS assessment nearest to the home health claim start date, beneficiary address reported on the home health claim, and the beneficiary county provided at month-level in the MBSF Base segment. If beneficiary county of residence/treatment was not available in any of these data sources, then the ZIP code of the HHA providing care was used to derive county information.

Health Conditions. The following chronic health conditions were reported for home health beneficiaries on an annual basis: chronic kidney disease, congestive heart failure, diabetes, ulcers, Alzheimer's disease or related senile dementia, ischemic heart disease, and anemia. These indicators were pulled from the MBSF Chronic Conditions and Other Chronic Conditions segments. The condition flags were provided at both the middle and end of each year for each Medicare beneficiary; for this report, only end-of-year condition flags were used. The original chronic condition flags have four levels: 1) neither claim nor coverage criteria were met; 2) claim criteria met, coverage criteria not met; 3) claim criteria not met, coverage criteria met; 4) claims and coverage criteria met. Claims criteria are met when the beneficiary has a claim that includes a related diagnosis or procedure code during the given condition's reference period. Coverage criteria are met when the beneficiary is enrolled in full FFS (Medicare Parts A and B) for the entire condition reference period. Our analyses reduced these chronic condition flags to three levels: 1) Beneficiary has condition (claims criteria were met, regardless of coverage criteria); 2) Beneficiary does not have condition (claims criteria were not met); 3) Beneficiary does not have MBSF Chronic Condition data available for the year.

Reason for Medicare Entitlement. Original and current reasons for Medicare entitlement were determined using the entitlement reason variables from the MBSF Base segment, associated with a claims-based home health episode based on the year in which the episode began. Beneficiary Medicare entitlement was coded as disabled, ESRD, or both.

Percentage of Persons aged 25 years or older with less than a high school diploma 2011-2015. The percentage of each level of education at the county level was reported on the AHRF data (see Section A.3.5). This value was calculated by dividing the number of individuals aged 25 years or older with less than a high school diploma by the standard education level denominator provided on the AHRF then multiplying by 100. This county-level metric was then matched to each home health episode based on the county in which care was provided (see Section A.4.4.1 for a detailed description in how county was determined).

OASIS Clinical Factors

Inpatient discharge within 14 days. For OASIS-based episodes of care, inpatient discharge within 14 days prior to the start of care was derived from OASIS assessment item M1000. For claims-based episodes, each home health beneficiary's FFS status was determined using the MBSF monthly indicators for the 14 days prior to the start of the episode. Among those beneficiaries who are Parts A & B eligible, inpatient and SNF claims were scanned for those with a CLM_THRU_DT (i.e. discharge) occurring within the 14-day lookback period.

Risk for hospitalization. For OASIS-based episodes of care, three indicators for risk for hospitalization were derived from one of two OASIS assessment items, depending on assessment version. For assessments using the C version, item M1032 was used, and for assessments using the C1 and later versions, item M1033 was used. The response categories differed across the two OASIS versions. For C1

and later (M1033), responses of '01' were coded as having a history of falls, responses of '03' were coded as having multiple hospitalizations, and responses of '07' were coded as taking five or more medications. For (M1032), responses of '03' were coded as having a history of falls, responses of '02' were coded as having multiple hospitalizations, and responses of '04' were coded as taking five or more medications.

Requires urinary catheter. For OASIS-based episodes of care, indicators for urinary incontinence or catheter presence were populated only in instances in which the patient had been discharged from an inpatient community (via M1000) or received a diagnosis requiring medical or treatment regimen change (via M1016 for C1 assessments or M1017 if C2 assessments). Among those patients, the indicator was populated when item M1610 had a response of '02.'

Surgical wound. For OASIS-based episodes of care, an indicator variable indicating that the patient has a surgical wound was populated based on OASIS assessment item M1340 with a response of '01,' indicating that the patient has an observable surgical wound.

Oxygen Therapy. The need for oxygen therapy used to be derived from item M1410 when the response was '01'. However, starting OASIS version D, the question M1410 was longer collected in the assessment form. Thus, a replacement for the OASIS-based oxygen variable was created using a combination of: primary and secondary diagnoses for supplemental oxygen reported on home health, DME, outpatient, physician-supplier, and inpatient claims, as well as OASIS Assessment items M1021 (primary diagnosis) and M1023 (secondary diagnoses). Specifically, the ICD9 code V462 and the ICD10 code Z9981 were used to identify oxygen use for home health, outpatient, physician-supplier, and inpatient claims, as well as OASIS question M1021 and M1023. DME claims would be flagged with oxygen use if HCPCS contained any of E1390, E1391, E0424, E0439, E1405, E1406, E0431, E0434, E1392, E0433, K0738, E0441, E0442, E0443 or E0444. In addition, the claim through dates of DME, outpatient, physician-supplier, and inpatient claims have to fall between 30 days before home health episode start date and home health episode end date.

Home Care Diagnosis: Neoplasms. For OASIS-based episodes of care, presence of neoplasm diagnosis were identified from a series of OASIS assessment items. We derived ***neoplasm diagnosis*** from a series of OASIS assessment items: M1020 (primary diagnosis ICD codes), M1022 (other ICD diagnosis codes), and M1024 (payment ICD diagnosis codes). These ICD codes were then used to indicate the presence of a diagnosis of neoplasm according to CMS documentation on OASIS measures.[15]

Stages of Pressure Ulcer: For OASIS-based episodes of care, indicators showing different stages of pressure ulcer were obtained from two OASIS items as shown below (Exhibit A-21)

[15] Hittle DF, Nuccio EJ. (2017) Home Health Agency Patient-Related Characteristics Reports: Technical Documentation of Measures - Revision 4.1. Prepared for: Department of Health and Human Services; Centers for Medicare & Medicaid Services. University of Colorado School of Medicine - Division of Health Care Policy and Research.

Exhibit A-21. Pressure Ulcers

OASIS Item	OASIS Question	Variables	OASIS Response
M1308 (version C1), M1311 (version C2) – Pressure Ulcers	Current Number of Unhealed Pressure Ulcers at Each Stage (or Unstageable)	Pressure Ulcer Stage 2	A
		Pressure Ulcer Stage 3	B
		Pressure Ulcer Stage 4	C
		Pressure Ulcer Not Stageable	D.1-D.3

Source: OASIS-C2 Guidance Manual

As noted in Section A.1.4.2, we adjusted for outcome-specific start of care indicators of patient status. More specifically, we included the indicator of a patient's status from the initial OASIS assessment corresponding to the OASIS outcome of interest being examined, as covariates in the respective D-in-D model. For example, for the Improvement in Pain Interfering with Activity OASIS outcome measure, we adjusted for the patient responses captured by the OASIS assessment question at the start of care (Exhibit A-22). Exhibit A-22 through Exhibit A-25 describe the responses for the OASIS assessment questions corresponding to the four OASIS improvement measures. Similarly, Exhibit A-26 through Exhibit A-36 describe the responses for the OASIS assessment questions that comprise the two TNC measures. In addition to being a component of the TNC Change in Mobility measure, ambulation and locomotion responses obtained from OASIS assessment question M1860 (Exhibit A-29) were included in the core set of factors for covariate adjustment (Section A.1.4.2).

Exhibit A-22. Pain

OASIS Item	OASIS Question	Variables	OASIS Response
M1242 – Pain	Frequency of pain interfering with patient's activity or movement	Pain does not interfere with activity	01
		Less often than daily pain	02
		Daily, but not constant pain	03
		Constant pain	04

Source: OASIS-C2 Guidance Manual

Exhibit A-23. Oral Medications

OASIS Item	OASIS Question	Variables	OASIS Response
M2020 – Oral Medications	Management of Oral Medications: Patient's current ability to prepare and take all oral medications reliably and safely, including administration of the correct dosage at the appropriate times/intervals. Excludes injectable and IV medications. (NOTE: This refers to ability, not compliance or willingness.)	Patient is able to take oral medications if prepared in advance/another person develops a drug diary	01
		Able to take medications at the correct time if given reminders by another person at the appropriate times	02
		Unable to take medication unless administered by another person	03

Source: OASIS-C2 Guidance Manual

Exhibit A-24. Dyspnea

OASIS Item	OASIS Question	Variables	OASIS Response
M1400 – Dyspnea	When is the patient dyspneic or noticeably short of breath?	Patient is short of breath only when walking more than 20 feet	01
		With moderate exertion	02
		With minimal exertion or at rest	03, 04

Source: OASIS-C2 Guidance Manual

Exhibit A-25. Wound Status

OASIS Item	OASIS Question	Variables	OASIS Response
M1342 – Wound Status	Status of Most Problematic Surgical Wound that is Observable	Fully granulating	01
		Early/partial granulation	02
		Not healing	03

Note: These indicators are only populated if M1340 = '00' or '02' (i.e., Does this patient have a surgical wound? 00 = No, 02 = Surgical wound known but observable due to non-removable dressing/device). | Source: OASIS-C2 Guidance Manual

Total Normalized Composite Start of Care Measures. The start of care values for the TNC measures are different from the other OASIS start of care values in that they are composites of multiple OASIS assessment items, the sum of responses ranging from 0 to 15 for the TNC mobility start of care measure and from 0 to 23 for the TNC self-care start of care measure, with larger values implying worse health conditions. In order to use these start of care values as covariates in the models for the respective TNC outcome measures, we grouped the composite (sum of responses) values into four categories each, ranging from a "most healthy" category to a "least healthy" category.

TNC mobility at the start of care is composed of three OASIS assessment items at the start of care: Toilet Transferring, Bed Transferring, and Ambulation. The category construction of this start of care measure as well as the description of the three components that make up this measure are shown below in Exhibit A-26 through Exhibit A-29.

Exhibit A-26. Total Normalized Composite Measure of Mobility at Start of Care

OASIS Item	OASIS Question	Category	Sum of OASIS Response
M1840 – Toilet Transferring, M1850 – Bed Transferring, M1860 – Ambulation/Locomotion	Total Normalized Composite Measure of Mobility at the Start of Care (sum of the three OASIS items)	Sum less than 4	0, 1, 2, 3
		Sum between 4 and 6, inclusive	4, 5, 6
		Sum between 7 and 9, inclusive	7, 8, 9
		Sum greater than or equal to 10	10, 11, 12, 13, 14, 15

Exhibit A-27. Toilet Transferring

OASIS Item	OASIS Question	Variables	OASIS Response
M1840 – Toilet Transferring	Current ability to get to and from the toilet or bedside commode safely and transfer on and off toilet/commode	Able to get to and from the toilet and transfer independently with or without a device	00
		When reminded, assisted, or supervised by another person, able to get to and from the toilet and transfer	01
		Unable to get to and from the toilet but is able to use a bedside commode (with or without assistance)	02
		Unable to get to and from the toilet or bedside commode but is able to use a bedpan/urinal independently	03
		Is totally dependent in toileting	04

Source: OASIS-C2 Guidance Manual

Exhibit A-28. Bed Transferring

OASIS Item	OASIS Question	Variables	OASIS Response
M1850 – Bed Transferring	Transferring: Current ability to move safely from bed to chair, or ability to turn and position self in bed if patient is bedfast	Able to independently transfer	00
		Able to transfer with minimal human assistance or with use of an assistive device	01
		Able to bear weight and pivot during the transfer but unable to transfer self	02
		Unable to transfer self and is unable to bear weight or pivot when transferred by another person	03
		Bedfast, unable to transfer but is able to turn and position self in bed	04
		Bedfast, unable to transfer and is unable to turn and position self	05

Source: OASIS-C2 Guidance Manual

Exhibit A-29. Ambulation/Locomotion

OASIS Item	OASIS Question	Variables	OASIS Response
M1860 – Ambulation/Locomotion	Current ability to walk safely, once in a standing position, or use a wheelchair, once in a seated position, on a variety of surfaces.	Able to independently walk on even and uneven surfaces and negotiate stairs with or without railings (specifically: needs no human assistance or assistive device)	00

OASIS Item	OASIS Question	Variables	OASIS Response
		Able to independently walk with the use of a one-handed device	01
		Requires two handed device or human assistance	02
		Walks only with supervision or assistance from another at all times	03
		Chairfast to bedfast	04, 05, 06

Source: OASIS-C2 Guidance Manual

TNC self-care at the start of care is composed of six OASIS assessment items at the start of care: Grooming, Upper Body Dressing, Lower Body Dressing, Bathing, Toileting Hygiene, Feeding or Eating. The category construction of this start of care measure as well as the description of the six components that make up this measure are shown below in Exhibit A-30 through Exhibit A-36.

Exhibit A-30. Total Normalized Composite Measure of Self-Care at Start of Care

OASIS Item	OASIS Question	Category	Sum of OASIS Response
M1800 - Grooming, M1810 – Ability to Dress Upper Body, M1820 – Ability to Dress Lower Body, M1830 - Bathing, M1845 – Toileting Hygiene, M1870 – Feeding or Eating	Total Normalized Composite Measure of Self-Care at the Start of Care (sum of the six OASIS items)	Sum less than 8	0, 1, 2, 3, 4, 5, 6, 7
		Sum between 8 and 10, inclusive	8, 9, 10
		Sum between 11 and 15, inclusive	11, 12, 13, 14, 15
		Sum greater than or equal to 16	16, 17, 18, 19, 20, 21, 22, 23

Exhibit A-31. Grooming

OASIS Item	OASIS Question	Variables	OASIS Response
M1800 – Grooming	Current ability to tend safely to personal hygiene needs (specifically: washing face and hands, hair care, shaving or make up, teeth or denture care, or fingernail care)	Able to groom self unaided, with or without the use of assistive devices or adapted methods	00
		Grooming utensils must be placed within reach before able to complete grooming activities	01
		Someone must assist the patient to groom self	02
		Patient depends entirely upon someone else for grooming needs	03

Source: OASIS-C2 Guidance Manual

Exhibit A-32. Ability to Dress Upper Body

OASIS Item	OASIS Question	Variables	OASIS Response
M1810 – Ability to Dress Upper Body	Current ability to dress upper body safely (with or without dressing aids) including undergarments, pullovers, front-opening shirts and blouses, managing zippers, buttons, and snaps	Able to get clothes out of closets and drawers, put them on and remove them from the upper body without assistance	00
		Able to dress upper body without assistance if clothing is laid out or handed to the patient	01
		Someone must help the patient put on upper body clothing	02
		Patient depends entirely upon another person to dress the upper body	03

Source: OASIS-C2 Guidance Manual

Exhibit A-33. Ability to Dress Lower Body

OASIS Item	OASIS Question	Variables	OASIS Response
M1820 – Ability to Dress Lower Body	Current ability to dress lower body safely (with or without dressing aids) including undergarments, slacks, socks or nylons, shoes	Able to obtain, put on, and remove clothing and shoes without assistance	00
		Able to dress lower body without assistance if clothing and shoes are laid out or handed to the patient	01
		Someone must help the patient put on undergarments, slacks, socks or nylons, and shoes	02
		Patient depends entirely upon another person to dress lower body	03

Source: OASIS-C2 Guidance Manual

Exhibit A-34. Bathing

OASIS Item	OASIS Question	Variables	OASIS Response
M1830 – Bathing	Bathing: Current ability to wash entire body safely. Excludes grooming (washing face, washing hands, and shampooing hair).	Able to bathe self in shower or tub independently, including getting in and out of tub/shower	00
		With the use of devices in shower/tub	01
		With intermittent assistance in shower/tub	02
		Participates with supervision in shower/tub	03
		Independent at sink, in chair, or on commode	04
		Participates with assist at sink, in chair, or commode	05
		Unable to participate; bathed totally by another	06

Source: OASIS-C2 Guidance Manual

Exhibit A-35. Toileting Hygiene

OASIS Item	OASIS Question	Variables	OASIS Response
M1845 – Toileting Hygiene	Toileting Hygiene: Current ability to maintain perineal hygiene safely, adjust clothes and/or incontinence pads before and after using the toilet, commode, bedpan, urinal. If managing ostomy, includes cleaning area around stoma, but not managing equipment	Able to manage toileting hygiene and clothing management without assistance	00
		Able to manage toileting hygiene and clothing management without assistance if supplies/implements are laid out for the patient	01
		Someone must help the patient to maintain toileting hygiene and/or adjust clothing	02
		Patient depends entirely upon another person to maintain toileting hygiene	03

Source: OASIS-C2 Guidance Manual

Exhibit A-36. Feeding or Eating

OASIS Item	OASIS Question	Variables	OASIS Response
M1870 – Feeding or Eating	Feeding or Eating: Current ability to feed self meals and snacks safely. Note: This refers only to the process of eating, chewing, and swallowing, not preparing the food to be eaten.	Able to independently feed self	00
		Able to feed self independently but requires: (a) meal set-up; OR (b) intermittent assistance or supervision from another person; OR (c) a liquid, pureed or ground meat diet	01
		Unable to feed self and must be assisted or supervised throughout the meal/snack	02
		Able to take in nutrients orally and receives supplemental nutrients through a nasogastric tube or gastrostomy	03
		Unable to take in nutrients orally and is fed nutrients through a nasogastric tube or gastrostomy	04
		Unable to takin in nutrients orally or by tube feeding	05

Source: OASIS-C2 Guidance Manual

A.2.1.2 Episode Characteristics

Episode Type. Home health claims-based episodes with outlier payment adjustments were identified using the variable claim value code = 17. Low Utilization Payment Adjustment (LUPA) payment adjustments were identified using the variable *CLM_HHA_LUPA_IND_CD*, and Partial Episode Payment (PEP) payment adjustments were identified using *PTNT_DSCHRG_STUS_CD = '06'.* Otherwise, all episodes without outlier, LUPA, or PEP adjustments were categorized as "Normal".

Episodes within a Sequence. Claims-based episode sequences were put together by combining episodes whose end date and start dates were within 60 days of one another; a gap of at least 60 days indicated the start of a new sequence. Three different categories of episodes were created depending on the order in which an episode appears relative to the larger sequence of episodes in which it occurs: first in a sequence, second in a sequence, and third or higher in a sequence. All episodes, regardless of episode type (i.e., normal, outlier, LUPA, PEP), were included. The logic we employed is in alignment with the methodology for determining home health stays for the two HHVBP claims-based measures.[22]

Visits in an Episode. Using the revenue center codes associated with each home health claim, visits per claims-based episode were counted for each type of home health service: physical therapy visit (revenue center code 042x), occupational therapy visit (revenue center code 043x), speech language pathology visit (revenue center code 044x), skilled nursing visit (revenue center code 055x), medical social services visit (revenue center code 056x), and home health aide visit (revenue center code 057x). These visits were then summed to calculate the total visits per claims-based episode.

Visits in an Episode by Type of Visit. Using the revenue center codes associated with each home health claim, visits per episode were counted for each type of home health service: physical therapy visit (revenue center code 042x), occupational therapy visit (revenue center code 043x), speech language

pathology visit (revenue center code 044x), skilled nursing visit (revenue center code 055x), medical social services visit (revenue center code 056x), and home health aide visit (revenue center 057x).

Hierarchical Condition Category (HCC) indicators and HCC risk scores. To evaluate the risk level of beneficiaries at the start of each home health episode, we calculated episode-level HCC and HCC risk scores by using Research Identifiable Files (RIFs) claims data and software (Version 21, published in 2014 and 2019) provided by CMS.[16] For this analysis, we focused on the first episode in the sequence only. Specifically, for each first home health episode in a sequence, we looked back 30 days to include all diagnosis codes from Part B carrier, inpatient, and outpatient claims. Only professional carrier claims were eligible to be included based on Healthcare Common Procedure Coding System (HCPCS) codes provided by CMS.[17] We excluded any carrier claims for which line item Berenson-Eggers Type of Service (BETOS) code variable equals D1A, D1B, D1C, D1D, D1E, D1F, D1G (which is durable medical equipment [DME]), or O1A (which is ambulance services). The intent of the algorithm was to exclude claims where the services do not require a licensed health care professional. In addition, we also excluded any outpatient claims that only included lab testing, based on revenue center files.

The model software created 87 HCCs and three HCC scores: new enrollees, institutional and community. Beneficiaries were assigned to one of the three HCC scores as follows:

- If a beneficiary was not fully enrolled in Medicare FFS for the past 12 months before the start of the home health episode, the new enrollee score was used.
- Otherwise, if at least one 90-day assessment exists in the Minimum Data Set (MDS) within the 365 days prior to the start of the home health episode, the institutional score was used.
- Otherwise, the community score was used.

For second or later home health episodes in the sequence, the HCC score from first home health episode was used.

The individual HCC indicators we used for analysis in annual report include:

- HCC 21: Protein-Calorie Malnutrition.
- HCC 23: Other Significant Endocrine and Metabolic Disorders.
- HCC 52: Dementia without Complication.
- HCC 78: Parkinson's and Huntington's Diseases.
- HCC 79: Seizure Disorders and Convulsions.
- HCC 85: Congestive Heart Failure.
- HCC 96: Specified Heart Arrhythmias.
- HCC 106: Atherosclerosis of the Extremities with Ulceration or Gangrene.
- HCC 159: Pressure Ulcer of Skin with Partial Thickness Skin Loss.
- HCC 170: Hip Fracture/Dislocation.
- HCC 176: Complications of Specified Implanted Device or Graft.

For beneficiaries with ESRD status at the start of the home health episode, we calculated an ESRD HCC risk score based on the Version 21 ESRD model software published by CMS.[16]

[16] See CMS Risk Adjustment model software. Available here.
[17] See CMS Medicare Risk Adjustment Eligible CPT/HCPCS Codes. Available here.

ESRD indicator: a home health episode level ESRD status was defined as either having an unfailed kidney transplant at the start of home health episode or having a dialysis claim during the 365 days before the home health episode begins. Dialysis claims were defined as facility type code equal to 7 and service classification type equal to 2 (i.e. first 2 digits of type of bill equals to 72). Acute kidney injury (AKI) dialysis claims were excluded if HCPCS code equals to G0491 or claim related condition code equals to 84. Similar to HCC score and HCC indicators, ESRD status was defined for the first episode in the sequence and the same value was used for second and later episodes in the sequence.

FFS 12 months before home health episode start: In a given month, a beneficiary was determined to be enrolled in "full" Medicare FFS if they were enrolled in both Parts A and Part B (including beneficiaries with dual enrollment in Medicare and Medicaid), and were concurrently not enrolled in an HMO. Based on this definition, monthly indicator variables were created to determine a beneficiary's full FFS enrollment status based on MBSF monthly enrollment indicators. Then a FFS 12 month indicator was created if a beneficiary was full FFS for all 12 months prior to the home health episode start (including the month of home health start date).

PDGM Case-Mix Group of an Episode. For home health services beginning on or after January 1, 2020, CMS implemented the Patient-Driven Groupings Model (PDGM)[18], a revised case-mix adjustment methodology that categorized home health episodes into 432 case-mix groups for the purposes of adjusting payment. We applied this PDGM approach back to home health episodes started from January 1, 2013 to December 31, 2019. In particular, home health episodes are placed into different subgroups for each of the following broad categories:

- Admission source. Per CMS PDGM rule, each home health episode was classified into one of two admission source categories: "community" or "institutional", depending on what healthcare setting was utilized in the 14 days prior to home health. The PDGM defines acute stays as inpatient acute care hospitalizations (ACH) and post-acute stays as inpatient psychiatric facility (IPF) stays, skilled nursing facility (SNF) stays, inpatient rehabilitation facility (IRF) stays, or long-term care hospital (LTCH) stays. Any home health episodes with acute stays within 14-days prior to a home health admission was designated as institutional admissions (For example, if the home health episode started on 01/15/2019, the lookback period was 01/01/2019-01/15/2019.). A post-acute stay in the 14 days prior to a 1st home health episode in the sequence or later episodes in the sequence with equal ''admission date'' and ''from date'' (which means the patient had been discharged from home health) would also classified as an institutional admission. All other home health episodes was designated as community admissions. For episodes with institutional admissions, we also recorded the facility type, claim from date and patient discharge status (PTNT_DSCHRG_STUS_CD) of the most recent institutional. Thus, 2 sets of admission sources variables were created, a 2 categorical set and a 6 categorical set:
    - Admission source (2 categories): community or institutional.
    - Admission source (6 categories): community, ACH, IPF, SNF, IRF or LTCH.
- Admission source (Arbor –defined) for frontloading analysis: For the purposes of frontloading analyses, "true" post-institutional episodes were determined based on two criteria: 1) The

[18] See 2019 Final Rule here.

episode was designated as "institutional" based on PDGM rules above and 2) the institutional claim linked to the HH episode contained a discharge status code[19] of either "06" or "86" indicating the patient was discharged to home health following release from the institution. All episodes not meeting these criteria were designated as community referrals.

- Timing (2 categories): early or late. Timing (early or late) was determined based on if there is a gap of at least 60-days between the end of one home health episode and the start of the next. When there was a gap of at least 60-days, the subsequent home health episode would be classified as being the first episode of a new sequence (and therefore, would be labeled as early). Otherwise, late.
- Clinical grouping (12 subgroups): musculoskeletal rehabilitation; neuro/stroke rehabilitation; wounds; medication management, teaching, and assessment (MMTA) - surgical aftercare; MMTA - cardiac and circulatory; MMTA - endocrine; MMTA - gastrointestinal tract and genitourinary system; MMTA - infectious disease, neoplasms, and blood-forming diseases; MMTA - respiratory; MMTA- other; behavioral health; or complex nursing interventions. The clinical grouping (12 subgroups) of each episode was determined based on the patient's principal diagnosis on the home health claim. The reported principal diagnosis provides information to describe the primary reason for which patients are receiving home health services under the Medicare home health benefit.
- Functional impairment level (3 subgroups): low, medium, or high. The functional impairment level (3 subgroups) of each episode was determined based on the following OASIS items: M1800, M1810, M1820, M1830, M1840, M1850, M1860 and M1033.
- Comorbidity adjustment (3 subgroups): none, low, or high based on secondary diagnoses. The comorbidity adjustment category (3 subgroups) of each episode was determined based on the presence of secondary diagnoses on the home health claim.

For each of the PDGM defined variables (except Arbor defined admission source for frontloading analysis), we focused on the 1st episode in the sequence only and used the information from first home health episode for second and subsequent home health episodes in the sequence. More details about the complete PDGM rules can be found in the home health final rule.[18]

A.2.1.3 HHA Characteristics

Total Number of HHAs. Home health claims and OASIS episodes of care were used to generate a list of all unique HHAs with at least one home health claim or OASIS episode of care in a specified time period.

Ownership. Using publicly available CMS Provider of Services (POS) data, HHAs were categorized as for-profit, non-profit, or government-owned, conditional on control type. From the provider data, control type is recoded as "non-profit" (control type codes 1,2,3), "for-profit" (control type code 4), and "government-owned" (control type codes 5,6,7).

Setting: Hospital-Based vs. Freestanding. Using publicly available CMS POS data, HHAs were categorized as freestanding or hospital-based conditional on facility type. From the provider data, facility type is recoded as "freestanding" (facility type codes 1,2,3,7) or "hospital-based" (facility type codes 4,5,6).

[19] Patient discharge status code obtained from ResDAC Patient Discharge Status Code (FFS).

HHA Age. HHA age was calculated for each episode based on the floored (i.e., rounding down to nearest integer) year difference between HHA original participation date and the episode start date (for claims-based episodes) or end date (for OASIS-based episodes). Categorical variables were also created for HHA age at 0~3 years, 4~10 years, and more than 10 years.

Chain Membership. HHA chain membership was determined for each individual year from 2013-2019 using two sources: Provider Enrollment, Chain and Ownership System (PECOS) and HHA Cost Report data. Using Cost Report data, chain affiliation was determined using the information reported on Line 29 of Worksheet S-2 for a given fiscal year. Extraction of PECOS chain affiliation data are described in Section A.3.9 below. PECOS-based chain affiliation data were assessed for any year in which the HHA was enrolled in Medicare (via the PECOS enrollment parent table) at the end of the CY. If the HHA met this condition and was also under ownership of a chain at the end of the CY, then the HHA was considered to be affiliated with a chain for that year. If the HHA was enrolled in Medicare at the end of the CY and was not under ownership of a chain at the end of the CY, then the HHA was not considered to be affiliated with a chain for that year. If the HHA did not have PECOS enrollment data covering the end of the CY, then chain affiliation based on PECOS data was considered missing.

Using the processed Cost Reports and PECOS, an agency was assigned chain membership if either data source indicated chain membership for the given year. If both sources indicated that the agency was not a chain, or if one source indicated not a chain and the other was missing, then the agency was assigned a non-chain status. If both sources were missing, then the prior year and following year were checked, and if the agency had the same status before and after, that status was assigned (e.g., if an HHA is chain in 2013, missing in 2014, and chain in 2015, their 2014 status would be set to “chain”).

For this report, we only updated an HHA’s chain affiliation indicator for CY 2019 based on updated cost report and PECOS data, as of July 2020; therefore, the chain affiliation indicator for an HHA in each of the years from 2013 through 2018 has been held constant from the previous Annual Report. We made this decision in order to mitigate the impact of inaccurate changes to historic provider enrollment and chain affiliation data that are introduced in sequential updates to the PECOS data, which we describe in further detail in Section A.3.9.

Newly available chain name information enabled us to enhance the chain status determination for this report. We used manual web searches and SAS automation to standardize the reported chain name and therefore increase the accuracy of our chain status assignment. Using the clean, standardized chain names, we added “Undetermined” to our chain status assignments of “Yes”, “No” or “Missing”. Agencies were classified as “Undetermined” if their chain names were linked to only a single agency in any given year (e.g., a potential “false positive” chain) or if a self-reported chain-affiliated agencies did not have a chain name.

HHA Size. HHA size was determined at an annual level by counting the number of OASIS episodes of care that end within a given year. Agencies were then further grouped into mutually exclusive categories based on the number of episodes they provided:

- 1-59 episodes
- 60-249 episodes
- 250-499 episodes

- 500-999 episodes
- 1000+ episodes

Profitability. Profitability measures the Medicare profit margin for agencies. The measure was defined as the difference between total Medicare payments for prospective payment system episodes and the total costs of Medicare services, including drugs and DME, divided by total Medicare payments for prospective payment system episodes, (payments – costs)/payments. Medicare payments and costs were taken from Medicare HHA and Hospital Cost Reports for freestanding and hospital-based agencies, respectively. Because cost reports may contain missing or extreme values, CMS, MedPAC, and others commonly trim the population of home health cost reports for statistical analysis. We utilized a trimming methodology previously employed by CMS to account for extreme values.[20] Given differences in cost structure and cost reporting between HHAs in freestanding and hospital settings, we restricted the trimmed sample used for our analysis to freestanding HHAs, which represent the vast majority of HHAs in HHVBP states. To control for extreme values within our trimmed sample, we categorized freestanding home health agencies based on their reported profit margins and use the median, rather than the mean, as a measure of central tendency.

A.2.2 Claims-Based Impact Measures

This section presents how the claims-based measures were created. Of note, the bottom row of each table notes the data source(s) used to create the impact measure. Each of the impact measures, episode-level numerator and denominator indicators were merged with other variables to create the analytic file (Sections A.4.2 and A.4.4) that was used to conduct the analyses and produce the results presented in the report.

Exhibit A-37. Average Number of FFS HH Episodes per 1,000 FFS Beneficiaries

Measure Concept	Definition
Measure Category	Quality
Measure Description	Number of claims-based HH episodes ending in a given year per 1,000 FFS beneficiaries alive at the beginning of the year.
Measure Numerator	Total number of claims-based HH episodes ending in the year.
Numerator Details	Numerator includes all claims-based HH episodes of all types (LUPAs, outliers, PEPs, etc.) irrespective of whether they are first, second, or higher in the sequence, ending in a given year.
Measure Denominator	Total number of Medicare-eligible FFS beneficiaries alive at the beginning of the given year divided by 1,000.
Denominator Details	Total number of Medicare-eligible FFS beneficiaries alive at the beginning of the year (e.g., if a beneficiary is no longer FFS next month, they are still included) is obtained and then the number is divided by 1,000.
Data Sources	MBSF, HHA Claims

[20] Abt Associates. (2013) Analyses in Support of Rebasing & Updating Medicare Home Health Payment Rates; Prepared for the Centers for Medicare and Medicaid Services. Available here.

Exhibit A-38. Percent of FFS Beneficiaries with at least one HH Episode

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percent of Medicare-eligible FFS beneficiaries with at least one claims-based HH episode in a given year indicating the beneficiary used HH services.
Measure Numerator	Total number of claims-based HH episodes ending in the year.
Numerator Details	Total number of Medicare-eligible FFS beneficiaries with at least one claims-based HH episode ending in a given year.
Measure Denominator	Total number of Medicare-eligible FFS beneficiaries alive at the beginning of the given year.
Denominator Details	Total number of Medicare-eligible FFS beneficiaries alive at the beginning of the year (e.g., if a beneficiary is no longer FFS next month, they are still included).
Data Sources	MBSF, HHA Claims

Exhibit A-39. Average Medicare Spending per Day during and following FFS Home Health Episodes of Care

Measure Concept	Definition
Measure Category	Spending
Measure Description	Average Medicare Part A and Part B payments (or "Expenditure Components" listed below) per day during and up to 37 days following HH episodes of care. This measure includes payments that occur between the start of the HH episode (start of care [SOC]) and a 37-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 37th day. The length of the look-out period (37-day) is composed of 7 days post last HH visit and additional 30 days thereafter or until the start of the next HH episode that begins on or before the 37th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Measure Numerator	Total Medicare Part A and Part B payments (or "Expenditure Components" listed below) between the SOC and a 37-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 37th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Numerator Details	Sum of Medicare payments on all Part A and Part B claims (or "Expenditure Components" listed below) with a claim start date (i.e., based on "CLM_FROM_DT") occurring between the SOC and a 37-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 37th day or until death or loss of FFS Part A eligibility; whichever comes earlier. Where applicable, the 37-day look-out period following the end of care is truncated to prevent possible double counting of payments for claims that occur during a subsequent HH episode beginning during this 37-day period.
Measure Denominator	Total number of eligible days accrued during and in periods of up to 37 days following the last HH visit date of all HH FFS episodes starting in a given calendar quarter.
Denominator Details	Denominator includes all days occurring between the SOC and a 37-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 37th day or until death or loss of FFS Part A eligibility, for HH episodes of all types (LUPAs, outliers, PEPs, etc.) starting in a given calendar quarter, irrespective of whether they are first, second, or higher episodes in a sequence. HH episodes are excluded in the absence of a HH visit date. The maximum number of days that can be included in the denominator is 97

Measure Concept	Definition
	days for a 60 day episode of care (60 + 37 days), unless the last HH visit date occurs before the HH episode claim end date and/or a subsequent HH episode, death, or loss of FFS Part A eligibility occurs prior to the end of the 37-day look–out period.
Expenditure Components	Besides the total Medicare Part A and Part B spending measure, we repeated the same calculation for each individual expenditure component, including: Medicare Part B carrier and DME combined, HH, Hospice, Inpatient, Outpatient Emergency Department and Observation Stays, other Outpatient, Outpatient types combined, and SNF and obtained average Medicare spending per day during and following FFS home health episodes of care for each of the expenditure components.
Data Sources	Medicare Part B carrier, DME, HH, Hospice, Inpatient, Outpatient, and SNF claims.

This measure along with each of the components were individually capped at both the lower and upper ends to reduce the influence of extreme expenditure outliers. For each year, the measure was capped at the 99th percentile of the unweighted spending per-day measure (i.e. any values greater than 99th percentile were set to the 99th percentile value), and any negative payment values were set to zero dollars.

Exhibit A-40. Average Medicare Spending per Day during FFS Home Health Episodes of Care

Measure Concept	Definition
Measure Category	Spending
Measure Description	Average Medicare Part A and Part B payments (or "Expenditure Components" listed below) per day during HH episodes of care. This measure includes payments that occur between the SOC and a 7-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 7th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Measure Numerator	Total Medicare Part A and Part B payments (or "Expenditure Components" listed below) between the SOC and a 7-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 7th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Numerator Details	Sum of Medicare payments on all Part A and Part B claims (or "Expenditure Components" listed below) with a claim start date (i.e., based on "CLM_FROM_DT") occurring between the SOC and a 7-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 7th day or until death or loss of FFS Part A eligibility; whichever comes earlier. Where applicable, the 7-day look-out period following the end of care is truncated to prevent possible double counting of payments for claims that occur during a subsequent HH episode beginning during this 7-day period.
Measure Denominator	Total number of eligible days accrued from all HH FFS episodes starting in a given calendar quarter.
Denominator Details	Denominator includes all days occurring between the SOC and a 7-day look-out period following the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 7th day or until death or loss of FFS Part A eligibility, for HH episodes of all types (LUPAs, outliers, PEPs, etc.) starting in a given calendar quarter, irrespective of whether they are first, second, or higher episodes in a sequence. HH episodes are excluded in the absence of a HH visit date. The maximum number of days that can be included in the denominator is 67 days for a 60 day episode of care (60 + 7 days), unless the last HH visit date occurs before the HH episode claim end date and/or a subsequent HH episode,

Measure Concept	Definition
	death, or loss of FFS Part A eligibility occurs prior to the end of the 7-day look–out period.
Expenditure Components	Besides the total Medicare Part A and Part B spending measure, we repeated the same calculation for each individual expenditure component, including: Medicare Part B carrier and DME combined, HH, Hospice, Inpatient, Outpatient Emergency Department and Observation Stays, other Outpatient, Outpatient types combined, and SNF and obtained average Medicare spending per day during FFS home health episodes of care for each of the expenditure components.
Data Sources	Medicare Part B carrier, DME, HH, Hospice, Inpatient, Outpatient, and SNF claims.

This measure along with each of the components were individually capped at both the lower and upper ends to reduce the influence of extreme expenditure outliers. For each year, the measure was capped at the 99th percentile of the unweighted spending per-day measure (i.e. any values greater than 99th percentile were set to the 99th percentile value), and any negative payment values were set to zero dollars.

Exhibit A-41. Average Medicare Spending per Day following FFS Home Health Episodes of Care

Measure Concept	Definition
Measure Category	Spending
Measure Description	Average Medicare Part A and Part B payments (or "Expenditure Components" listed below) per day that occur after the 7th day following the last HH visit (end of care) and over the subsequent 30 days or until the start of the next HH episode that begins on or before the 30th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Measure Numerator	Total Medicare Part A and Part B payments (or "Expenditure Components" listed below) within 30 days following the 7th day after the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 30th day or until death or loss of FFS Part A eligibility; whichever comes earlier.
Numerator Details	Sum of Medicare payments on all Part A and Part B claims (or "Expenditure Components" listed below) with a claim start date (i.e., based on "CLM_FROM_DT") occurring within 30 days following the 7th day after the last HH visit (end of care) or until the start of the next HH episode that begins on or before the 30th day or until death or loss of FFS Part A eligibility; whichever comes earlier. Where applicable, the 30-day downstream period is truncated to prevent possible double counting of payments for claims that occur during a subsequent HH episode beginning during this 30-day period.
Measure Denominator	Total number of eligible days accrued from periods of up to 30 days that occur after the 7th day following the last HH visit date of HH FFS episodes starting in a given calendar quarter.
Denominator Details	Denominator includes all days accrued from periods following the 7th day after the last HH visit date, for HH episodes of all types (LUPAs, outliers, PEPs, etc.) starting in a given calendar quarter, irrespective of whether they are first, second, or higher episodes in a sequence. HH episodes are excluded if: 1. There are no HH visit dates reported. 2. A measurement time period is not available since the claim start date ("CLM_FROM_DT") on a subsequent HH episode, date of death, or loss of FFS Part A eligibility does not exceed the last HH visit date of the HH episode by more than 1 day.

Measure Concept	Definition
	The maximum number of days that can be included in the denominator is 30 days, unless a subsequent HH episode, death, or loss of FFS Part A eligibility occurs prior to the end of the 30-day downstream period.
Expenditure Components	Besides the total Medicare Part A and Part B spending measure, we repeated the same calculation for each individual expenditure component, including: Medicare Part B carrier and DME combined, Hospice, Inpatient, Outpatient Emergency Department and Observation Stays, other Outpatient, Outpatient types combined, and SNF and obtained average Medicare spending per day following FFS home health episodes of care for each of the expenditure components.
Data Sources	Medicare Part B carrier, DME, Hospice, Inpatient, Outpatient, and SNF claims.

This measure along with each of the components were individually capped at both the lower and upper ends to reduce the influence of extreme expenditure outliers. For each year, the measure was capped at the 99th percentile of the unweighted spending per-day measure (i.e. any value greater than 99th percentile were set to the 99th percentile value), and any negative payment values were set to zero dollars.

Exhibit A-42. Outpatient Emergency Department Use (no Hospitalization)/First FFS Home Health Episodes

This impact measure is similar to the HHVBP measure, "Emergency Department Use without Hospitalization".[21] However, unlike the HHVBP measure, it is not risk adjusted.

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays in which patients used the ED but were not admitted to the hospital during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for outpatient ED use and no claims for ACH in the 60 days following the start of the HH stay.
Numerator Details	The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare outpatient claim with any emergency room revenue center codes (0450-0459, 0981) during the 60 day window AND if the patient has no Medicare inpatient claims for admission to an acute care hospital (identified by the CMS Certification Number [CCN] on the inpatient claim ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window, then the stay is included in the measure numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days.

[21] See CMS Specifications for Home Health Claims-Based Utilization Measures, "Emergency Department Use without Hospitalization."

Measure Concept	Definition
	4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	Claims Predicted Probability file

Exhibit A-43. Inpatient Emergency Department Use/First FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays in which patients used the inpatient ED services during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for inpatient ED use in the 60 days following the start of the HH stay.
Numerator Details	The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare inpatient claim with any emergency room revenue center codes (0450-0459, 0981) during the 60 day window, then the stay is included in the measure numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	MBSF, HHA Claims, Inpatient Claims. Enrollment status and beneficiary death date are obtained from MBSF.

Exhibit A-44. Outpatient and Inpatient Emergency Department Use/First FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays in which patients used either the outpatient ED services or the inpatient ED services during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for either outpatient ED use or inpatient ED use in the 60 days following the start of the HH stay.
Numerator Details	The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare outpatient claim or inpatient claim with any emergency room revenue center codes (0450-0459, 0981) during the 60 day window, then the stay is included in the measure numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.

Measure Concept	Definition
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	MBSF, HHA Claims, Inpatient Claims, Outpatient claims. Enrollment status and beneficiary death date are obtained from MBSF.

Exhibit A-45. Outpatient Emergency Department and Observation Stay Use (no Hospitalization)/First FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays in which patients used the ED or observation stays but were not admitted to the hospital during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for outpatient ED and observation stay use and no claims for ACH in the 60 days following the start of the HH stay.
Numerator Details	The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare outpatient claim with any emergency room revenue center codes (0450-0459, 0981), observation room revenue center codes (0760-0769), or observation HCPCS codes (99217-99220, 99224-99226, 99234-99236, G0378-G0379) during the 60 day window AND if the patient has no Medicare inpatient claims for admission to an acute care hospital (identified by the CMS Certification Number [CCN] on the inpatient claim ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window, then the stay is included in the measure numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	Claims Predicted Probability file

Exhibit A-46. Unplanned Acute Care Hospitalization/First FFS Home Health Episodes

This impact measure is similar to the HHVBP measure, "Acute Care Hospitalization".[22] However, unlike the HHVBP measure, it is not risk adjusted.

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays in which patients were admitted to an acute care hospital during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for an admission to an acute care hospital in the 60 days following the start of the HH stay.
Numerator Details	The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare inpatient claim from short term or critical access hospitals (identified by the CCN on the inpatient claim ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window, then the stay is included in the measure numerator. Note that planned hospitalizations are excluded from the numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	Claims Predicted Probability file

Exhibit A-47. Unplanned Acute Care Hospitalization/All FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH episodes with at least one unplanned admission to an acute care hospital within 60 days of the start of the episode or until the start of the next HH episode that begins on or before the 60th day.
Measure Numerator	Number of HH episodes with at least one unplanned admission to an acute care hospital within 60 days of the start of the episode or until the start of the next HH episode that begins on or before the 60th day.
Numerator Details	▪ The 60-day time window is calculated by adding 59 days to the "from" date of the HH episode. If a subsequent HH episode starts on or before the 60th day, the time window is ended early on the day prior to the start of the next episode. ▪ ACH occurs (and the HH episode is included in the numerator) if the patient has at least one Medicare inpatient claim from short-stay or critical access hospitals during the 60-day window. ▪ Planned hospitalizations (defined by a list of AHRQ Procedure and Condition CCS and additional ICD-9-CM procedure codes) are excluded from the measure numerator. The measure specifications, including the

[22] See CMS Specifications for Home Health Claims-Based Utilization Measures, "Acute Care Hospitalization."

Measure Concept	Definition
	AHRQ codes, were pulled from the CMS Home Health Claims-Based Utilization Measures Specifications.[22]
Measure Denominator	Total number of eligible HH episodes starting in a given quarter.
Denominator Details	All HH episodes that start in the quarter are included with the following exclusions: ▪ HH episodes for patients who are alive and are not continuously enrolled in FFS Medicare for the 60 days following the start of the HH episode. ▪ HH episodes for patients who were not FFS eligible in the six months prior. ▪ HH episodes that begin with a LUPA claim. ▪ HH episodes in which the patient receives service from multiple agencies during the 60-day window (see "Transfer HHAs within 60 days" in Glossary [Section A.5]).
Data Sources	MBSF, HHA Claims, Inpatient Claims. Enrollment status and beneficiary death date are obtained from MBSF.

Exhibit A-48. Rehospitalization (Overall)/First FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays that started within 14 days of discharge from a hospital with at least one Medicare ACH claim during the 60 days following the start of the HH stay.
Measure Numerator	Number of HH stays for patients who have a Medicare claim for an admission to hospital in the 14 days before the start of the HH stay and for an admission to an acute care hospital in the 60 days following the start of the HH stay.
Numerator Details	The 14 day time window is calculated by subtracting 14 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare inpatient claim then we check the 60 days period. The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare inpatient claim from short term or critical access hospitals (identified by the CCN on the inpatient claim ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window, then the stay is included in the measure numerator. Note that planned hospitalizations are excluded from the numerator.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay with at least one Medicare inpatient claim in the 14 days look back period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	MBSF, HHA Claims, Inpatient Claims

Exhibit A-49. Rehospitalization for Same/Different MDC as an Index Medical Hospitalization

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH stays that started within 14 days of discharge from a hospital with Medical type index hospitalization and with same/different group of Medicare ACH claim diagnosis during the 60 days following the start of the HH stay.
Measure Numerator for same MDC	Number of HH stays for patients who have a Medical type index Medicare claim for an admission to hospital in the 14 days before the start of the HH stay and an Medical type Medicare claim for an admission to an acute care hospital in the 60 days following the start of the HH stay with the same MDC as that of the index hospitalization.
Measure Numerator for different MDC	Number of HH stays for patients who have a Medical type index Medicare claim for an admission to hospital in the 14 days before the start of the HH stay and an admission to an acute care hospital in the 60 days following the start of the HH stay due to either a surgical type claim or a Medical claim with a different MDC than that of the index hospitalization.
Numerator Details	The 14 day time window is calculated by subtracting 14 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. Medical or Surgical type Hospitalization was determined by DRG code (see Section A.3.3 for details). If the patient has at least one index Medicare inpatient claim then we check the 60 days period. The 60 day time window is calculated by adding 60 days to the "from" date in the first HH claim in the series of HH claims that comprise the HH stay. If the patient has at least one Medicare inpatient claim from short term or critical access hospitals (identified by the CCN on the inpatient claim ending in 0001-0879, 0800-0899, or 1300-1399) during the 60 day window, then the stay is included in the measure numerator. Note that planned hospitalizations are excluded from the numerator, and we only included the information from the first hospitalization that happened during the 60 days period. See Section A.3.3 for MDC details.
Measure Denominator	Number of HH stays that begin during the 12-month observation period. A HH stay with at least one Medical type index Medicare inpatient claim in the 14 days look back period. A HH stay is a sequence of HH payment episodes separated from other HH payment episodes by at least 60 days.
Denominator Details	See below for exclusions about HH stay construction. 1. HH stays for patients who are not continuously enrolled in Medicare FFS for the 60 days following the start of the HH stay or until death. 2. HH stays that begin with a LUPA claim. 3. HH stays in which the patient receives service from multiple agencies during the first 60 days. 4. HH stays for patients who are not continuously enrolled in Medicare FFS for the 6 months prior to the HH stay.
Data Sources	MBSF, HHA Claims, Inpatient Claims

Exhibit A-50. Mortality Rate/All FFS Home Health Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH episodes in which the beneficiary died either 1) within 60 days of the start of the episode or 2) before the start of the next HH episode that begins on or before the 60th day, whichever comes first.
Measure Numerator	Number of HH episodes in which the beneficiary died within 60 days of the start of the episode or until the start of the next HH episode that begins on or before the 60th day.
Numerator Details	▪ The 60-day time window is calculated by adding 59 days to the "from" date of the HH episode. If a subsequent HH episode starts on or before the 60th day, the lookout window is ended early on the day prior to the start of the next episode. The truncation of the lookout period, wherever applicable, is done to avoid double counting of the event. ▪ Death occurs (and the HH episode is included in the numerator) if the patient has a non-missing death date during the 60-day window.
Measure Denominator	Total number of eligible HH episodes starting in a given quarter.
Denominator Details	All HH episodes that start in the quarter are included with the following exclusions: ▪ HH episodes for patients who are alive and are not continuously enrolled in FFS Medicare for the 60 days following the start of the HH episode. ▪ HH episodes for patients whose non-missing death date is before the episode start date
Data Sources	MBSF (for enrollment status and beneficiary death date) and HHA Claims.

Exhibit A-51. Skilled Nursing Facility Use/All FFS HH Episodes

Measure Concept	Definition
Measure Category	Quality
Measure Description	Percentage of HH episodes with at least one admission to a SNF within 60 days of the start of the HH episode or until the start of the next HH episode that begins on or before the 60th day.
Measure Numerator	Number of HH episodes with at least one admission to a SNF within 60 days of the start of the HH episode or until the start of the next HH episode that begins on or before the 60th day.
Numerator Details	▪ The 60-day time window is calculated by adding 59 days to the "from" date of the HH episode. If a subsequent HH episode starts on or before the 60th day, the time window is ended early on the day prior to the start of the next episode. ▪ The SNF admission is counted if the patient has at least one SNF claim during the 60-day window. ▪ SNF admissions following planned ACH (defined by a list of AHRQ Procedure and Condition CCS and additional ICD-9-CM procedure codes) are excluded from the measure numerator under the following conditions: 1. The planned hospitalization starts within the HH episode 60-day window. 2. The planned hospitalization ends within the HH episode 60-day window. 3. The SNF stay starts within the HH episode 60-day window. 4. The SNF stay starts on or after the planned hospitalization end date.
Measure Denominator	Total number of eligible HH episodes starting in a given quarter.
Denominator Details	All HH episodes that start in the quarter are included with the following exclusions: ▪ HH episodes for patients who are alive and are not continuously enrolled in FFS Medicare for the 60 days following the start of the HH episode. ▪ HH episodes for patients who were not FFS eligible in the six months prior. HH episodes that begin with a LUPA claim. HH episodes in which the patient receives service from multiple agencies during the 60-day window (see "Transfer HHAs within 60 days" in Glossary [[Section A.5]).
Data Sources	HHA Claims, SNF Claims, MBSF, Inpatient RIF. Enrollment status is identified using the Medicare Enrollment Database.

A.2.3 OASIS-Based Outcome Impact Measures

This section presents information on the OASIS-based outcome impact measures analyzed in this report. Of note, the measure values were included as part of our Quality Improvement and Evaluation System (QIES) extract (see Section A.3.6.2); no additional measure calculations were necessary. The tables below summarize the measure definitions, as defined by CMS.[23]

Exhibit A-52. Discharged to Community

Measure Concept	Definition
Measure Category	OASIS Outcome
Measure Description	Percentage of HH episodes after which patients remained at home.
Measure Numerator	Number of HH episodes where the assessment completed at the discharge indicates the patient remained in the community after discharge.
Measure Denominator	Number of HH quality episodes ending with a discharge or transfer to inpatient facility during the reporting period, other than those covered by generic or measure-specific exclusions.
Measure-Specific Exclusions	HH quality episodes that end in patient death.

Source: CMS OASIS-C2 Home Health Outcome Measures

Exhibit A-53. Total Normalized Composite Change in Mobility

Measure Category	OASIS Composite Outcome
Data Source	OASIS M1840, M1850, M1860
Measure Description **	This measure captures the change in home health patients' mobility between start or resumption of care (SOC/ROC) and the end of care (EOC). It is a composite of three OASIS items related to mobility (i.e. toilet transferring M1840, bed transferring M1850, and ambulation/locomotion, M1860).
Measure Calculation	Firstly, the raw change for each applicable OASIS item at the episode level between SOC/ROC and EOC is computed. Secondly, the normalized change (value between -1 and 1) for each applicable OASIS item at the episode level is calculated by dividing the raw change by maximum possible change value for the respective OASIS item. Then the normalized change for all applicable OASIS items at the episode level are summed up. Sum Normalized Change in Mobility = M1840 Normalized Change + M1850 Normalized Change + M1860 Normalized Change. This ranges from -3 to 3. Sum Normalized Change in Mobility (calculated in previous step) for all eligible home health quality episodes are then aggregated at the agency level and divided by Agency total number of eligible home health quality episodes.

***Because the TNC Change in Mobility measure is a composite measure rather than simply an outcome measure, the terms "Numerator" and "Denominator" do not apply*

Source: HHVBP Computing the HHVBP Composite Measures; HHVBP Technical Specification Resources for Composite Outcome Measures

[23] See CMS OASIS-C2 Home Health Outcome Measures.

Exhibit A-54. Total Normalized Composite Change in Self-Care

Measure Category	OASIS Composite Outcome
Data Source	OASIS M1800, M1810, M1820, M1830, M1845, M1870
Measure Description**	This measure captures the change in home health patients' self-care between start or resumption of care (SOC/ROC) and the end of care (EOC). It is a composite of six OASIS items related to self-care (i.e.,M1800 grooming, M1810 upper body dressing, M1820 lower body dressing, M1830 bathing, M1845 toilet Hygiene, and M1870 eating).
Measure Calculation**	Firstly, the raw change for each applicable OASIS item at the episode level between SOC/ROC and EOC is computed. Secondly, the normalized change (value between -1 and 1) for each applicable OASIS item at the episode level is calculated by dividing the raw change by maximum possible change value for the respective OASIS item. Then the normalized change for all applicable OASIS items at the episode level are summed up. Sum Normalized Change in Self Care = M1800 Normalized Change + M1810 Normalized Change + M1820 Normalized Change + M1830 Normalized Change + M1845 Normalized Change + M1870 Normalized Change. This ranges from -6 to 6. Sum Normalized Change in Self-Care (calculated in previous step) for all eligible home health quality episodes are then aggregated at the agency level and divided by Agency total number of eligible home health quality episode.

**Because the TNC Change in Self-Care measure is a composite measure rather than simply an outcome measure, the terms "Numerator" and "Denominator" do not apply

Source: HHVBP Computing the HHVBP Composite Measures; HHVBP Technical Specification Resources for Composite Outcome Measures

Exhibit A-55. Improvement in Dyspnea

Measure Concept	Definition
Measure Category	OASIS Outcome
Measure Description	Percentage of HH quality episodes during which the patient became less short of breath or dyspneic.
Measure Numerator	Number of HH quality episodes where the discharge assessment indicates less dyspnea at discharge than at SOC/ROC.
Measure Denominator	Number of HH quality episodes ending with a discharge during the reporting period, other than those covered by generic or measure-specific exclusions.
Measure-Specific Exclusions	HH quality episodes for which the patient, at SOC/ROC, was not short of breath at any time, or episodes that end with inpatient facility transfer or death.

Source: CMS OASIS-C2 Home Health Outcome Measures

Exhibit A-56. Improvement in Management of Oral Medications

Measure Concept	Definition
Measure Category	OASIS Outcome
Measure Description	Percentage of HH quality episodes during which the patient improved in ability to take their medicines correctly (by mouth).
Measure Numerator	Number of HH quality episodes where the value recorded on the discharge assessment indicates less impairment in taking oral medications correctly at discharge than at SOC/ROC.
Measure Denominator	Number of HH quality episodes ending with a discharge during the reporting period, other than those covered by generic or measure-specific exclusions.
Measure-Specific Exclusions	HH quality episodes for which the patient, at SOC/ROC, was able to take oral medications correctly without assistance or supervision, episodes that end with inpatient facility transfer or death, patient is nonresponsive, or patient has no oral medications prescribed.

Source: CMS OASIS-C2 Home Health Outcome Measures

Exhibit A-57. Improvement in Pain Interfering with Activity

Measure Concept	Definition
Measure Category	OASIS Outcome
Measure Description	Percentage of HH quality episodes during which the patient's frequency of pain when moving around improved.
Measure Numerator	Number of HH quality episodes where the value recorded on the discharge assessment indicates less frequent pain at discharge than at SOC/ROC.
Measure Denominator	Number of HH quality episodes ending with a discharge during the reporting period, other than those covered by generic or measure-specific exclusions.
Measure-Specific Exclusions	HH quality episodes for which the patient, at SOC/ROC, had no pain reported, episodes that end with inpatient facility transfer or death, or patient is nonresponsive.

Source: CMS OASIS-C2 Home Health Outcome Measures

Exhibit A-58. Improvement in Status of Surgical Wounds

Measure Concept	Definition
Measure Category	OASIS Outcome
Measure Description	Percentage of HH quality episodes during which the patient demonstrates an improvement in the condition of surgical wounds.
Measure Numerator	Number of HH quality episodes where the patient has a better status of surgical wounds at discharge compared to SOC/ROC.
Measure Denominator	Number of HH quality episodes ending with a discharge during the reporting period, other than those covered by generic or measure-specific exclusions.
Measure-Specific Exclusions	HH quality episodes for which the patient, at SOC/ROC, did not have any surgical wounds or had only a surgical wound that was unobservable or fully epithelialized, or episodes that end with inpatient facility transfer or death.

Source: CMS OASIS-C2 Home Health Outcome Measures

A.2.4 HHCAHPS-Based Impact Measures

For the five HHVBP performance measures that address beneficiary experience, we used the publicly available, HHA-level HHCAHPS data for CYs 2013 – 2019. To receive the annual Home Health Prospective Payment System payment update, HHAs that do not qualify for an exemption from participating in the HHCAHPS Survey must contract with an approved HHCAHPS Survey vendor, administer the survey on an ongoing (monthly) basis, and submit HHCAHPS Survey data to the HHCAHPS Data Center on a quarterly basis. Agencies are exempted if they serve 59 or fewer survey-eligible patients a year. Survey-eligible patients are those who are at least 18 years old and have their skilled care covered by Medicare or Medicaid.[24]

The five measures—constructed from 19 HHCAHPS questions—are summarized below.[25]

1. **How often the home health team gave care in a professional way (Professional Care)** reflects "patients who reported that their home health team gave care in a professional way."[25] This composite measure is comprised of four HHCAHPS questions that address how frequently the HHA treated the patient gently, with courtesy and respect, how frequently the HHA seemed informed and up-to-date, and if the patient had any problems with the care received.
2. **How well did the home health team communicate with patients (Communication)** reflects "patients who reported that their home health team communicated well with them."[25] This composite measure is comprised of six HHCAHPS questions related to different aspects of communication, including how frequently the HHA explained things in an easy to understand manner, listened carefully, and kept the patient informed about when staff would arrive.
3. **Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)** reflect "patients who reported that their home health team discussed medicines, pain, and home safety with them."[25] This composite measure is comprised of seven HHCAHPS questions related to these three areas of care (that is, medicines, pain, and home safety).
4. **How do patients rate the overall care from the home health agency (Overall Care)** is a global rating measure that reflects the percentage of respondents who gave a rating of 9 or 10 to the question, "Using any number from 0–10, where 0 is the worst home health care possible, and 10 is the best home health care possible, what number would you use to rate your care from this agency's home health providers?"[25]
5. **Would patients recommend the home health agency to friends and family (Likely to Recommend)** is a global rating measure that reflects the percentage of respondents who answered "Definitely Yes" to the question, "Would you recommend this agency to your family and friends if they needed home health care?"[25]

A.2.5 Measures Related to Entry/Exit

These two measures are reported through Quarter 2 of 2019 due to a lag in the reporting of POS data (see Section A.3.4 for details).

[24] Additional criteria are available here.
[25] Additional information on measure construction available here.

Exhibit A-59. Entering Home Health Agencies, Percent

Measure Concept	Definition
Measure Category	HHA Entry and Exit
Measure Description	Percentage of open HHAs that are new in a given quarter.
Measure Numerator	Count of HHAs with an original Medicare participation date occurring in a given quarter.
Numerator Details	N/A
Measure Denominator	Total number of open HHAs of the given quarter.
Denominator Details	Excluding HHAs located in DC or any U.S. territory.
Data Sources	POS

Exhibit A-60. Exiting Home Health Agencies, Percent

Measure Concept	Definition
Measure Category	HHA Entry and Exit
Measure Description	Percentage of open HHAs that close in a given quarter.
Measure Numerator	Count of HHAs with a Medicare termination date occurring in a given quarter.
Numerator Details	N/A
Measure Denominator	Total number of open HHAs of the given quarter.
Denominator Details	Excluding HHAs located in DC or any U.S. territory.
Data Sources	POS

A.2.6 Alternative Payment Models (APM)

The APMs that were active anytime between 2013-2019 and for which data were available are the BPCI Initiative, CJR, OCM, and three ACO initiatives:

Bundled Payments for Care Improvement (BPCI) Initiative: Under this voluntary initiative, participating ACHs and post-acute care providers (PACs) received bundled payments, as opposed to fragmented, individual service-based payments, for all services rendered during a defined episode of care. BPCI providers were offered incentives based on lowering expenditures and improving quality of care. Two of the four models (Model 2 and 3) for participation in this initiative included bundled payments for post-acute care, and episodes of care for specific clinical outcomes were grouped into "clinical episodes" for the purposes of evaluation.[26] The performance period for the original BPCI model ran from 2013 through Q3 of 2018. Beginning October 2018, a new iteration of this model, BPCI Advanced, went live and is set to run through December 2023.

Comprehensive Care for Joint Replacement (CJR) Model: This model was designed to facilitate better quality and more efficient care for Medicare beneficiaries undergoing hip and knee replacements. The performance period for this model began in April 2016 and will continue through December 2020. Participation was mandatory for all hospitals in 67 randomly selected Metropolitan Statistical Areas (MSA) for the first two years of the model. From CY 2018 onwards, all rural and lower-volume hospitals as well as all other hospitals located in 33 of the 67 MSAs were permitted to participate on a voluntary basis. A CJR episode of care begins with admission to a participant hospital for a beneficiary discharged under MS-DRG 469 or 470 and ends 90 days post-discharge to account for the complete period of recovery. CJR hospital expenditures are evaluated for annual reconciliation compared to performance-

[26] See BPCI general information page, available here.

adjusted target episode prices. Through this reconciliation, participating hospitals may be owed money from or owe money to CMS, depending on quality and spending compared to episode targets.[27]

Oncology Care Model (OCM): The OCM was initiated by CMS in order to promote higher-quality, coordinated care to Medicare FFS beneficiaries undergoing chemotherapy at a lower cost. An episode of care begins with the initiation of chemotherapy, continues for six months and includes all Medicare Part A and B services as well as certain Part D services that FFS beneficiaries receive during that period. Participating oncology care providers receive monthly payments for each aligned beneficiary, as well as retrospective performance-based payments based on the quality of care provided and reduced spending relative to a target-price set by CMS. The OCM is a voluntary model that began in July 2016 and will continue through June 2021 nationally.[28]

Accountable Care Organizations: ACOs are multi-disciplinary provider groups (doctor's offices, hospitals, and other providers including home health agencies) who come together voluntarily to provide consistent, efficient, and cost-effective care. By providing a continuous, coordinated care. ACOs aim to avoid unnecessary duplication of services and to prevent medical errors.[29] Since the enactment of the Affordable Care Act, CMS has established a number of ACO-centered alternative payment models. As of 2019, the number of ACOs participating in the Medicare Share Savings Program ACO initiative had grown to 541, with an estimate of servicing around 11.2 million FFS beneficiaries nationwide.[30] The CMS ACO initiatives for which we have data include:

- **Medicare Shared Savings Program** (MSSP) – For providers serving FFS beneficiaries. The SSP model facilitates coordinated care among providers and suppliers to promote higher quality and more efficient care. MSSP offers multiple options where participating providers may select the level of financial risk they are willing to incur.[31] MSSP is currently active.
- Two additional Center for Medicare & Medicaid Innovation (CMMI) models, **the Advanced Payment ACO Model** and the **ACO Investment Model**, were designed to shepherd ACO-based by current or newly established MSSP providers care into rural and/or underserved areas:
    - **Advanced Payment ACO Model** – Model incentivized rural and physician-based providers to join together voluntarily to provide Medicare FFS beneficiaries better-coordinated and higher-quality care. These newly-formed ACOs, which were commonly smaller and lacking necessary resources for MSSP participation, received both upfront and monthly payments to invest in patient care and infrastructure through the MSSP.[32] The Advanced Payment ACO Model is no longer active.
    - **ACO Investment Model** – Model tests the use of pre-paid shared savings to encourage previously- and newly-established MSSP ACOs to expand to rural and underserved areas.[33] The ACO Investment Model is currently active.
- **Pioneer ACO Model** – Designed to transition health care organizations and providers already experienced in coordinating care for patients across care settings into ACO-based care more

[27] See CJR information page, available here.
[28] See OCM information page, available here.
[29] See ACO information page, available here.
[30] See CMS' Health Affairs blog post on the MSSP, available here.
[31] See MSSP information page, available here.
[32] See Advance Payment ACO Model general information page, available here.
[33] See ACO Investment Model general information page, available here.

quickly. These experienced organizations were expected to take on a slightly higher level of financial risk than SSP ACOs and consequently stood to receive greater shared savings. The model was run similarly to, though separately from the SSP.[34] The Pioneer ACO Model is no longer active.

- **Next Generation ACO Model** – For ACOs experienced in managing care for populations of patients. In this model, participating ACOs assume greater financial risk than those participating in the SSP model, with the possibility for greater financial rewards. This model was designed to test the effect of strong financial incentives and increased resources for improved patient care and management, on improving patient outcomes and decreasing ACO expenditures.[35] The Next Generation ACO Model is currently active.

Exhibit A-61 summarizes the active dates for the APMs used in our analyses.

Exhibit A-61. Active Dates and Data Availability for Alternative Payment Models

Alternative Payment Model	2013	2014	2015	2016	2017	2018	2019
BPCI-Models 2 & 3	✓	✓	✓	✓	✓	✓	
BPCI Advanced						✓	✓
CJR				✓	✓	✓	✓
OCM				✓	✓	✓	✓
ACO Initiatives							
Pioneer ACO	✓	✓	✓	✓			
MSSP*	✓	✓	✓	✓	✓	✓	✓
Next Generation ACO				✓	✓	✓	✓

** Includes the Advanced Payment ACO and ACO Investment Model (AIM)*

A.2.7 Total Performance Score

Guided by parameters established by CMS for CY 2016,[36] the 2013-2017 TPS were calculated as an aggregate performance metric based on 17 HHVBP measures, including: seven OASIS-based outcomes, three OASIS-based processes, two claims-based measures, and the five HHCAHPS measures.[37]

HHA measure rates were created as 12-month weighted averages, weighted by the episode counts, and rolled up from the agency-month to the agency-year level. An HHA's Performance Year measure rates (ranging from 0 – 100 points) were compared to its baseline year measure rates, as well as state-level performance standards: the achievement thresholds (ATs) and benchmarks (BMs). In the HHVBP Model, the baseline year is defined as CY 2015. For our computation of the TPS for years prior to the implementation of HHVBP, we defined the baseline year as the year prior to the designated Performance Year (e.g., for our calculation of TPS values for CY 2014, we used CY 2013 as the baseline year). ATs and BMs for each measure were calculated based on the distribution of baseline year measure rates for all eligible participating HHAs within a given state (see below for eligibility criteria). For each eligible measure, HHAs received the higher of either an Achievement Score or an Improvement

[34] See Pioneer ACO Model general information page, available here.
[35] See Next Generation ACO Model general information page, available here.
[36] See 2015 HHVBP Final Rule.
[37] Scores for the three new self-reported measures were not factored into our calculation of the TPS since these data are unavailable for non-HHVBP HHAs. Thus, the adjusted composite score for the 17 performance-based measures will be given full weight, as compared to the 90% weight that has been stipulated by CMS.

Score, between 0 and 10 points. Achievement/Improvement Scores were summed across all eligible measures to form an unadjusted performance measure score. For each HHA, this score was then weighted based on the number of eligible measures reported. Note that we excluded Medicaid-certified only HHAs from the ATs/BMs/TPS calculation.

HHA eligibility criteria for the calculation of the ATs and BMs are as follows:

- For OASIS and claim-based measures, an HHA must have at least 20 episodes of care in the baseline year.
    - If an HHA did not have 20 or more episodes of care for a particular measure, the reported measure rates were recoded as missing.
- For HHCAHPS-based measures, an HHA must have at least 40 completed patient surveys during the baseline year for the five measure rates.
    - If an HHA did not have 40 or more completed patient surveys, the five HHCAHPS measure rates were recoded as missing.
- An HHA must have non-missing data for at least five of 17 eligible measures.
    - An "eligible measure count" (0 – 17) was created to tally the number of non-missing measures for each HHA to determine their inclusion/exclusion from AT/BM calculations.

HHA eligibility criteria for the calculation of TPS are as follows:

- HHAs must have data from the full 12 months of baseline year.
    - HHAs were flagged based on their participation date, extracted from the POS file. HHAs with a participation year greater than or equal to the baseline year were excluded from the data set of eligible agencies.
- HHAs must be in operation as of the end of the performance year or as of the release of the latest available POS file.
    - HHAs were flagged based on their termination status, extracted from the POS file; HHAs that were flagged as terminated (termination year is the same as or before the performance year and non-missing as of the POS data extraction) were excluded from the data set of eligible agencies.
- HHAs must have at least five eligible measures for both the baseline year and the performance year.
    - For measure-level eligibility, see prior list above ("HHA eligibility criteria for calculations of AT/BMs").
- Of an HHA's eligible measures, at least five measures must be the same for both the baseline year and the performance year.
    - HHAs that did not have at least five shared measures between the baseline and performance years were excluded from the data set of eligible agencies.

Similarly, guided by parameters established by CMS for CY 2018,[38] the 2018 TPS were calculated as an aggregate performance metric based on 16 HHVBP measures: seven OASIS-based outcome measures, two OASIS-based process measures (of note, the drug education measure was dropped for CY 2018 and all subsequent years), two claims-based measures, and the five HHCAHPS-based measures. The measure

[38] See 2017 Final Rule here.

eligibility criteria, measure score calculation and HHA eligibility criteria remain the same as previous years.

Finally, guided by parameters established by CMS for CY 2019,[39] the 2019 TPS were calculated as an aggregate performance metric based on 13 HHVBP measures: six OASIS-based outcome measures, two claims-based measures, and the five HHCAHPS-based measures. Of note, the Influenza immunization measure and Pneumococcal vaccine measure were dropped for CY 2019 and all subsequent years, and three OASIS-based outcome measures (Improvement in Bathing, Bed, and Ambulation) were replaced by two composite measures: Total Normalized Composite (TNC) Change in Self-Care and TNC Change in Mobility. The measure eligibility criteria and HHA eligibility criteria remain the same as previous years. The maximum amount of improvement points was reduced from 10 points to 9 points for CY 2019 and subsequent performance years for all measures except for the two TNC measures, for which the maximum improvement points would be 13.5. In addition, for CY 2019 and subsequent performance years, the methodology for calculating the TPS by weighting the measure categories changed significantly such that the OASIS-based measure category and the claims-based measure category would each count for 35 percent, and the HHCAHPS measure category would count for 30 percent of the TPS that is based on performance of the Clinical Quality of Care, Care Coordination and Efficiency, and Person and Caregiver-Centered Experience measures.

Using the above methodology, we calculated the TPS for 2013 – 2019. We then validated our TPS calculations in the HHVBP group against those calculated by the HHVBP Implementation Contractor and reported in the Final Annual TPS and Payment Adjustment Report (released November 2017), the Preview Annual TPS and Payment Adjustment Report (released August 2018), the Preview Annual TPS and Payment Adjustment Report (released August 2019), the Preliminary Annual TPS and Payment Adjustment Report (released October 2020) for 2016 TPS, 2017 TPS, 2018 TPS, and 2019 TPS, respectively. Compared to the HHVBP Implementation Contractor, we included 24 additional HHAs in the 2016 TPS calculation, 15 additional HHAs in the 2017 TPS calculation, 16 additional HHAs in the 2018 TPS calculation, and 17 additional HHAs in the 2019 TPS calculation. Our inclusion of additional HHAs that were eligible for a TPS were due to differences in timing of access to the underlying measure data. Among HHAs that were included in both our and the HHVBP Implementation Contractor's calculations, the TPS were very close (e.g., correlation coefficient between our TPS and the HHVBP Implementation Contractor's TPS was 0.999 for the first three years (i.e., 2016 – 2018), and the correlation coefficient between our TPS and the HHVBP Implementation Contractor's TPS was 0.998 for 2019).

A.2.8 HHVBP Self-Reported Performance Measures

HHAs self-report three measures through the CMS Secure Portal:

1. The proportion of eligible HHA personnel vaccinated for influenza within the year.
2. The proportion of patients aged 60 or older who either received or reported having a herpes zoster vaccination.
3. The proportion of patients who have an advance care plan or surrogate decision-maker documented in their medical record, or who had a documented discussion about advance care plans or surrogate but refused or were unable to provide the information.

[39] See 2018 Final Rule here.

HHA performance regarding these measures was based on the reporting status (i.e., reported/not reported) for each measure. A binary variable indicating the reporting status of each measure (i.e., reported/not reported) at the HHA-level was available from the CMS Secure Portal. We calculated the proportion of HHAs that reported each measure. The numerator included all HHAs that reported the measure of interest, and the denominator included all HHAs operating under the HHVBP Model.

A.2.9 Relative Change

The relative change provides context for interpreting model estimates and indicates the magnitude by which the impact measures have changed due to HHVBP in the post-implementation period relative to the baseline period values. We calculated the relative change by dividing the respective D-in-D estimate by its measure's corresponding baseline average value in HHVBP states and expressing it as a percentage. For example, the cumulative D-in-D estimate of 0.31 for ED Use (no Hospitalization)/First FFS HH Episodes reported in Exhibit 46 of the Annual Report was divided by its baseline average of 11.7 percent to yield a 2.6 percent increase (0.31/11.7=0.026).

A.2.10 Annual Savings Calculations

We estimated the annual savings to the Medicare program by multiplying the yearly D-in-D estimate for the Medicare spending per day measures by the total number of eligible days in the HHVBP states for the respective year. Similarly, we obtained estimates of total savings since implementation of HHVBP by multiplying the cumulative D-in-D estimate for the Medicare spending per day measures (Exhibit 57) by the total number of eligible days during 2016 – 2019 in the HHVBP states (Exhibit C-36). To obtain estimates of average annual savings due to HHVBP, we then divided the calculated total savings estimate (obtained from the cumulative D-in-D estimate) by the number of years in the post-implementation period (in this case, four years).

To illustrate with an example, average daily Medicare spending during and following home health episodes among FFS beneficiaries declined by $1.76/day in HHVBP states, relative to non-HHVBP states for 2016 – 2019 (i.e., the cumulative D-in-D estimate reported in Exhibit 57 in the Annual Report).

- The number of eligible days in HHVBP states for 2016 – 2019 included in the calculation of this measure is 343,645,407 (Exhibit C-36).
- We multiplied the D-in-D estimate (which corresponds to estimated savings per day) by the total number of days during the corresponding time period to estimate the reduction in total Medicare spending over the four-year period (2016 – 2019): $1.76 savings/day * 343,645,407 days = $604,815,916.32.
- We then divided this number by 4 to estimate the average annual savings during 2016 – 2019 among FFS beneficiaries receiving home health services: $604,815,916.32/4 = $151,203,979.08, or $151 million after rounding.

Average annual savings corresponding to Medicare component expenditure estimates are calculated exactly in the same way, by multiplying the respective cumulative D-in-D estimates of the measure components (Exhibit C-39) by the total number of eligible days during 2016 – 2019 in the HHVBP states and dividing the total savings by the number of post-implementation years.

A.3 Data Sources

For this Annual Report, we accessed CMS administrative data from several sources, including the Chronic Conditions Data Warehouse (CCW) via the Virtual Research Data Center, publicly available data sources, and other CMS HHVBP Contractors. We also received varying analytic levels of measure-specific OASIS data, extracted from CMS' iQIES. We used these data sources to create the analytic file necessary to conduct the analyses included in this Annual Report. Claims-based impact measures were calculated and analyzed using several data sources, including:

- Common Medicare Environment (CME) enrollment data
- HHA claims
- SNF claims
- Inpatient hospitalization claims
- Outpatient claims (e.g. EDs, renal dialysis facilities, outpatient rehabilitation facilities)
- Part B claims
- DME claims
- Hospice claims
- Provider of Services (POS) files
- Area Health Resource File (AHRF)

The data sources discussed below were combined to create impact measures and descriptive variables, inform and construct comparison groups, and contribute to the analytic file that was used to conduct the analyses and produce the results presented in the report. Below, we describe the process for obtaining data from these sources in more detail.

A.3.1 Home Health Agency Claims

Purpose. HHA claims defined the home health care episodes for the claims-based impact measures.

Data Acquisition. HHA claims data were pulled from the CCW's RIFs in July 2020, which included all final action claims with claim type code 10 and a service end date (claim "through" date) ranging from January 1999 through June 2020. Although the measurement period for this evaluation began in January 2013, prior years of HHA claims data were needed to establish accurate episode sequence information.

Data Processing. In order to establish the complete set of home health episodes of care, all final-action HHA claims that met the following conditions were included:

- Claim frequency code not equal to each of the following: missing; '0' (Non-payment/Zero Claim); or '2' (Request for Anticipated Payment)
- Included at least one covered visit
- Received a Medicare payment amount greater than $0

Furthermore, if a beneficiary had multiple claims with the same "Statement Covers From" date (i.e., "claim from" date), only the claim with the latest Fiscal Intermediary claim process date was included. In the event that multiple claims for the same beneficiary overlap in a statement period "from" and "through" dates, the "Statement Covers Through" date (i.e., "claim through" date) on the claim starting earlier was adjusted to be the date before the ensuing claim from date. These data steps ensure that a given beneficiary could not be attributed to multiple HHAs on a given day when calculating episode-based impact measures (discussed below).

Each of the resulting HHA claims were considered a final home health episode with episode start date corresponding to the "claim from" date, and episode end date corresponding to the "claim through" date. In concordance with the measure specifications for the two HHVBP claims-based measures,[22] sequence of episodes (or "home health stay") was defined as a series of consecutive home health episodes for a given beneficiary in which the maximum time between consecutive episodes, end date to start date, was 60 days or less. If the time between the prior episode end date and ensuing episode start was greater than 60 days, the ensuing episode start date began a separate home health stay.

An important by-product of HHA claims processing is a beneficiary finder file that includes a unique list of all beneficiaries with a claims-based home health episode ending on or after January 1, 2013, which includes the full measurement period associated with this report (2013 – 2019). For the remainder of this report, we refer to this data set as the "HH Beneficiary Finder File."

A.3.2 Master Beneficiary Summary File

Purpose. MBSF data were the source for determining: beneficiary eligibility in impact measures based on FFS enrollment status, beneficiary demographics, and chronic condition status.

Data Acquisition. MBSF data, sourced from the Common Medicare Environment, were included in the CCW as annual snapshots that were divided into multiple segments: Base (Parts A/B/C/D), Chronic Conditions, Other Chronic or Potentially Disabling Conditions, Cost and Use, and National Death Index. For this Annual Report, we utilized the Base, Chronic Conditions, and Other Chronic Conditions segments.

The MBSF Base segment data provided monthly indicators of enrollment status, in addition to beneficiary demographic information (e.g., state and county of residence, date of birth, gender, race, etc.), for all Medicare enrollees. For this report, beneficiary year-level MBSF Base data were compiled from 2013 to 2019. For beneficiary gender, race, date of birth and date of death, only information from the most recent year of available MBSF for a given beneficiary was included in analyses.

As of the time of this report, the MBSF Chronic Conditions and Other Chronic or Potentially Disabling Conditions segments contained 67 beneficiary-year-level condition flags that were "developed from algorithms that search the CMS administrative claims data for specific diagnosis codes, Medicare Severity Diagnosis Related Group (MS-DRG) codes, or procedure codes."[40] The condition flags were provided at both the middle and end of each year for each Medicare beneficiary; for this report, only end-of-year condition flags were used.

Data Processing. In a given month, a beneficiary was determined to be enrolled in "full" Medicare FFS if they were enrolled in both, Parts A and B (including beneficiaries with dual enrollment in Medicare and Medicaid), and were concurrently not enrolled in an HMO. Based on this definition, monthly indicator variables were created to determine a beneficiary's full FFS enrollment status, which was later used as one of the factors to determine eligibility in claims-based impact measure denominator populations (See Section A.2.2).

End-of-year condition indicator variables from both Chronic Condition MBSF segments indicated whether the beneficiary met the CCW claims criteria and/or whether the beneficiary meets the

[40] See CCW Condition Categories.

coverage criteria (enrolled in Medicare Parts A and B for the entire specified period). From these indicator variables, we further derived condition flags that indicate whether a beneficiary met the claims criteria portion of the CCW condition algorithm, regardless of whether the beneficiary met the FFS coverage criteria (FFS coverage is separately accounted for in the MBSF Base segment).

The total number of Medicare-eligible FFS beneficiaries alive at the beginning of every quarter (e.g., if a beneficiary is no longer FFS next month, they are still included) was also calculated and then divided by 1000.

A.3.3 Non-Home Health Agency Claims

Purpose. We analyzed non-home health claims in order to create impact measures for spending and utilization of services outside of home health care. These claims were also used to determine a beneficiary's care setting immediately prior to a sequence of home health episodes. In this section, we discuss preliminary data processing to support impact measure calculation.

Data Acquisition. For this Annual Report, final action SNF (claim type codes 20 and 30), Inpatient (claim type code 60), and Outpatient (claim type code 40) claims were pulled from the CCW RIFs in July 2020, including claims with a claim through date from April 2010 through June 2020. Claims occurring in this date range potentially contributed to impact measure calculation and determining a home health beneficiary's prior care setting.

Additionally, all claims featuring a beneficiary in our home health Beneficiary Finder File were pulled in July 2020 from the CCW RIFs for Part B, DME, home health, Hospice, SNF, Inpatient, and Outpatient for claims with a claim through date from October 2011 through June 2020. This set of claims was used to calculate total Medicare expenditures and HCC risk scores for FFS home health beneficiaries.

Data Processing. For impact measure calculation, SNF stays were constructed based on SNF claims with an admission date starting on or after October 1, 2011; furthermore, this set of claims was subset to include only claims corresponding to beneficiaries in the HH Beneficiary Finder File (see Section A.3.1). SNFs submit monthly claims throughout a beneficiary's duration of stay, which spans from admission date to discharge date; therefore, a beneficiary's SNF stay was constructed by combining each of the individual SNF claims with the same associated admission date. The SNF stay start date corresponded to the first claim's "claim from" date, while the SNF stay end date corresponded to the last claim's "claim through" date. Medicare payment amounts for each claim within a given stay were summed up to a final stay-level payment amount.

Inpatient and outpatient claims were used to support impact measures related to unplanned ACH and ED use, spending and utilization of services. Inpatient claims were included for beneficiaries in the HH Beneficiary Finder File. Planned ACH inpatient claims were determined by scanning all diagnoses (ICD 9 or 10 codes) reported on the inpatient claim and cross-referenced the list of AHRQ CCS that defined planned hospitalization, as was done in the measure developer's documentation for the two HHVBP claims-based measures.[22] Medical or Surgical type diagnosis and Major Diagnostic Categories were also included in inpatient claims. Medical or Surgical type of diagnosis were derived from MS-DRG[41]: a medical DRG is assigned when no significant procedure was performed, and surgical DRG is assigned when a significant procedure was performed. Major Diagnostic Categories (MDC) are formed by dividing

[41] See MS-DRG Classifications and Software, available here.

all possible principal diagnoses (from MS-DRG) into 26 mutually exclusive diagnosis areas largely corresponding to a single organ system. Outpatient claims were included for beneficiaries in the HH Beneficiary Finder File. Outpatient claims with ED visits were identified by the presence of revenue center codes 0450-0459 or 0981. This approach is in alignment with the measure developer's documentation for the HHVBP claims-based ED use without hospitalization measure.[22] We also marked inpatient claims with ED visits using the same approach. In addition, we added flags for inpatient and outpatient claims with observation services for spending analysis, if the HCPCS code of the claim contains any of (99217, 99218, 99219, 99220, 99224, 99225, 99226, 99234, 99235, 99236, G0378 or G0379) or presence of revenue center codes 0760, 0761, 0762 or 0769.

For the purposes of total expenditure calculations, all claims for home health beneficiaries were pulled from Part B, DME, home health, Hospice, SNF, Inpatient, and Outpatient CCW RIFs. Claim payment amount was summed across all claims based on each home health episode (for full expenditure measure specifications, see Section A.2.2).

A.3.4 Provider Data

Purpose. We utilized publicly available data on HHAs to control for a variety of agency characteristics (i.e., ownership status, hospital-based vs. freestanding) in construction of comparison groups and D-in-D modeling.

Data Acquisition. Provider data was downloaded from the CMS "Provider of Services" site.

Data Processing. The final annual POS data sets from each year 2013 – 2019 were subset to HHAs based on provider category code "5". Control types provided in the POS data were re-coded into larger groups of "non-profit" (control type codes 1,2,3; church, private not-for-profit, and other, respectively), "for-profit" (control type code 4; private for-profit), and "government-owned" (control type codes 5,6,7; federal, state, and local, respectively). Additionally, facility type codes were re-coded into groups of "hospital-based" (facility type codes 4,5,6; rehabilitation facility, SNF, and hospital, respectively), and "freestanding" (facility type codes 1,2,3,7; visiting nurse association, combination government voluntary, official health agency, and other, respectively). For agencies that first show up in the POS data after their certification dates, we backfilled their characteristics for the years in between (including the year of certification).

A.3.5 County-Level AHRF Data

Purpose. Utilize county-level data from the AHRF to inform comparison group construction based on key county-level demographic information.

Data Acquisition. AHRF data are publicly available from the Health Resources and Services Administration data warehouse, from which we downloaded the 2019 county-level data set.

Data Processing. The following data elements from the AHRF data set were used in the analyses: indication of whether the county was in a rural or urban area (based on CBSA indicator), and the county level average education. The rural/urban variable was used to define rurality of a county, including beneficiaries receiving care in that county, across all analyses. The county level average education was used to define the percentage of persons aged 25 years and older in a county with less than a high school diploma.

A.3.6 OASIS Data

A.3.6.1 Predicted Probabilities for the Risk Adjusted OASIS-Based Outcome Impact Measures

Purpose. We obtained predicted probabilities for the risk adjusted OASIS-based outcome impact measures to support OASIS-based outcomes impact measure calculation and analysis.

Data Acquisition. We received OASIS-based episode-level data (extracted from QIES, later renamed to iQIES starting 2019) for each of the HHVBP OASIS-based outcome impact measures, in which episodes of care were determined from a series of OASIS assessments and had an episode end date ranging from 2013 through 2019.

Data Processing. The data set contained episode-level measure-specific observed and predicted probability values for each of the HHVBP OASIS-based outcome impact measures, as well as a state and facility identifier (unique only within a given state) in which the episode of care occurred. The combination of state and facility identifier were used to look up the HHA's CCN using the CCW's HHA facility file.

A.3.6.2 QIES Roll-Up Measure Data for the OASIS-Based Process Measures

Purpose. We obtained QIES roll-up measure data for OASIS-based process measures in order to calculate and analyze the OASIS-based process impact measures.

Data Acquisition. We received HHA-month-level data sets (extracted from QIES, later renamed to iQIES starting 2019, as well as Abt for 2019 data only) that contain observed measure values and episode counts for each of the process measures, spanning 2013 through 2019.

Data Processing. Similar to the episode-level QIES data set described above, the data set also contained state and facility identifier (unique only within a given state) in which the episode of care occurred; the combination of state and facility identifier were used to look up the HHA's CCN using the CCW's HHA facility file.

A.3.6.3 Raw OASIS Assessment Data

Purpose. Raw item-level OASIS data for January 2010 to December 2019were obtained to provide covariates for our analytic models and support our OASIS impact measure analyses.

Data Acquisition. Assessment data were extracted from the CCW Oracle database. We note that the CCW team identified an issue with the beneficiary identifiers in the OASIS Assessment files that impacted the December 2019 OASIS assessment and prevented the CCW team from being able to fully assign CCW Bene IDs to the data files. As of September 2020, the issue was still not resolved, but given that it only affects one month of data, we expect this issue to have a very limited (if any) impact on the analysis of the results presented in this Annual Report

Data Processing. The assessments were subset to versions C, C1, C2 or D. The most recent SOC/ROC assessments for each beneficiary were flagged based on M0100. Risk factor variables were calculated based on raw assessment data according to CMS documentation[42]. Response-level indicator variables

[42] Hittle DF, Nuccio EJ. (2017) Home Health Agency Patient-Related Characteristics Reports: Technical Documentation of Measures - Revision 4.1. Prepared for: Department of Health and Human Services; Centers for Medicare & Medicaid Services. *University of Colorado School of Medicine - Division of Health Care Policy and Research*.

were created for a subset of assessment items, including M0100, M1000, M1810, M1620, M1710, M1870, M2110, M1800, M1880, M1730, M1308, M1311, M2200, M1830, M1400, M1610, M1034, M1840, M1860, M2020, M1720, M1230, M1220, M1870, and M1910. Patient diagnostic information, from which chronic and acute conditions were derived, was pulled from items M1010, M1016, M1011, M1017, M1020, M1022, M1024, M1021, M1023, and M1025.

A.3.7 HHCAHPS and Star Ratings Data

Purpose. We utilized HHCAHPS data to analyze the five patient experience impact measures.

Data Acquisition. We downloaded publicly available data from the Home Health Compare (HHC) website in July 2019 for CYs 2013 – 2018.[43] For 2019 HHCAHPS data, we received the data directly from RTI.

Data Processing. The HHCAHPS data included a score value for each of the five HHCAHPS-based impact measures (see Section A.2.4), rounded to the nearest whole number, HHA's CCN, the number of completed surveys by respondents that received care from the given HHA, and the response rate. For this report, we used data from the January through December report from each year of our analyses, 2013 – 2019 (i.e., measurement period is the CY).

A.3.8 New Measures Data

Purpose. To provide descriptive statistics on the three new agency-reported measures.

Data Acquisition. We downloaded the Final Annual TPS and Payment Adjustment Report for CY 2019, made available on the CMS Enterprise Portal on November 23, 2020.

Data Processing. This report provided HHA-level indicators for whether the agency reported on each of the three measures, in addition to providing the number of points earned for each new measure, and how these points were weighted to contribute to the final TPS.

A.3.9 Provider Enrollment, Chain and Ownership System Data

Purpose. PECOS data were used to determine HHA chain information.

Data Acquisition. PECOS data were downloaded from the Integrated Data Repository in multiple iterations corresponding to monthly updates of the PECOS enrollment and chain affiliation data.

Data Processing. In order to determine HHA chain affiliation at a given point in time, we extracted data from two views in the Medicare Virtual Data Mart: V2_MDCR_PRVDR_MDCR_ID (parent table for PECOS enrollment database) and V2_MDCR_PRVDR_CHAIN (provider chain affiliation history). All available data were extracted for providers that were identified as HHAs, based on the last four digits of CCN, by joining the two data views based on the tables' key identifier: PRVDR_ENRLMT_ID. The resulting data set provided a history of chain affiliation for each HHA represented in the PECOS database. This process was repeated in multiple iterations from July 2018 through July 2020, in order to account for monthly updates to the PECOS enrollment and chain affiliation data. Per CMS Integrated Data Repository (IDR) Support, the PECOS data extracts they receive via the "Global Extract File" do not consistently and reliably preserve historical enrollment and chain affiliation data; therefore, we decided to combine monthly extracts and, for each HHA, choose the most recent extract in which the HHA was present.

[43] These data are available here.

Further, as described in Section A.2.1.3, the most recent chain affiliation data extracted from PECOS would only contribute to the chain affiliation indicator for CY 2019 in this report, while pre-2019 chain affiliation data would be carried over from the previous Annual Report.

A.3.10 Cost Reports

Purpose. Public use HHA Cost Report files (CMS Form 1728-94 and Form 2552-10) for fiscal years 2012–2019 were used to obtain chain information and to calculate profitability.

Data Acquisition. Cost Report data sets for both freestanding and hospital-based HHAs are publicly available via CMS' Healthcare Cost Report Information System.[44]

Data Processing. The fiscal year 2019 Cost Report file was not finalized at time of reporting, and all records for 2019 represented the most current data available. For any provider number with more than one Cost Report record in a given year, the Cost Report representing the latest fiscal year end date was maintained for analyses.

A.3.11 MedPAR

Purpose. The Medicare Provider Analysis and Review (MedPAR) file for CYs 2013-2018 were used to identify hospitalizations of FFS Medicare home health users prior their home health episode for analyses of changes in functional status at the OASIS SOC. MedPAR data were used rather than the inpatient claims data (claim type code 60; Section A.3.3) as the former provides access to summary characteristics for inpatient stays.

Data Acquisition. Final MedPAR RIFs were pulled from the CCW in November 2019.

Data Processing. MedPAR records were linked to OASIS data using beneficiary ID and hospital discharge date from MedPAR, and the SOC date listed in the OASIS assessment. OASIS and MedPAR records were matched when the SOC date was no later than 30 days from the hospital discharge date for a particular beneficiary.

A.3.12 Master Data Demonstration (MDD)

Purpose. Identify Medicare FFS beneficiaries who were aligned with ACOs (i.e., MSSP ACO, the Next Generation ACO Model, and the Pioneer ACO Model) during their home health episode.

Data Acquisition. The MDD is available in the CMS Virtual Research Data Center (VRDC) as part of the CCW, in association with the CMS Master Data Management (MDM) system. The data were pulled from the MDD library using the extracts from multiple dates, depending on the specific ACO model.

Data Processing. For the MSSP, we obtained the finalized list of retrospectively aligned beneficiaries for 2013-2019 from the MDD_BENE_EXTRACT_LINKED_200717 extract. SSP ACO-aligned beneficiaries were identified by program_id = '08' and bene_ctgry_cd = 'F', which includes beneficiaries aligned to the Advance Payment ACO and ACO Investment Model.

For the Next Generation ACO, we obtained prospectively aligned beneficiaries for 2016-2019 from the first MDD_BENE_EXTRACT_LINKED extract released in March of the year following the year of interest. Next Generation ACO beneficiaries were identified by program_id = '21'.

[44] These data are available here.

For the Pioneer ACO, we obtained prospectively aligned beneficiaries for 2013-2016 from the first MDD_BENE_EXTRACT_LINKED extract released in March of the year following the year of interest. Pioneer ACO beneficiaries were identified by program_id = '07'. Beneficiary alignment effective and alignment end dates were used.

With these data, we defined a window of ACO participation. In combination with home health episode start and end dates, we created a flag for Medicare home health beneficiaries whose home health episode overlapped with participation in an ACO.

A.3.13 Data from CMMI

Purpose. Identify Medicare FFS beneficiaries who were aligned with the BPCI Model (specifically, Model 2 or Model 3), the BPCI Advanced Model, the CJR model or the OCM during their home health episode.

Data Acquisition. These files were provided directly by CMMI, covering Q3 2013 through Q3 2018 for BPCI, Q4 2018-Q4 2019 for BPCI Advanced, Q2 2016 through Q4 2019 for CJR and Q3 2016 through Q4 2019 for OCM.

Data Processing. The data sets contained beneficiary-level information on APM clinical episode begin date and end dates. With these data, we defined a window of model participation. In combination with home health episode start and end dates, we created a flag for Medicare home health beneficiaries whose home health episode overlapped with participation in BPCI, BPCI Advanced, CJR or OCM.

A.3.14 Data from the HHVBP Implementation Contractor

Purpose. To support calculating a TPS for HHAs in the non-HHVBP states, which can be used as a metric to compare HHAs in non-HHVBP states with HHAs in HHVBP states.

Data Acquisition. We requested QIES measure roll-up extracts spanning 2013 – 2019 and HHA size data.

Data Processing. With guidance from the HHVBP Implementation Contractor, we received the QIES roll-up data sets that align in content with those used to produce the Annual TPS and Payment Adjustment Report; however, the variable timing of QIES data extracts, as compared to those used by the Implementation Contractor, may result in small discrepancies in measure values. We also received an HHA-level file containing metrics of HHA size, including a count of episodes and unique beneficiaries during 2015; these values were used by the HHVBP Implementation Contractor to determine the size cohort for each of the HHAs that were subject to payment adjustment. These files, in conjunction with the publicly reported HHCAHPS measure data, allowed us to calculate a TPS for both HHVBP and non-Model HHAs, which served as an impact measure for comparative analyses between HHAs in non-HHVBP states and HHVBP states.

A.3.15 Data from the HHVBP Technical Assistance Contractor

Purpose. To conduct descriptive analysis that assesses use and utilization of the HHVBP Connect website.

Data Acquisition. We requested and obtained HHVBP Connect data for CY 2019 from the HHVBP Technical Assistance contractor.

Data Processing. With guidance from the HHVBP Technical Assistance Contractor, we compiled the multiple data files into an annual file for 2019 which included monthly unique visitors, resource download, and webinar participation.

A.4 Analytic File Creation

Below, we first describe the methods that were employed for the different subtopics that are included in the main report, followed by a description of how we created a single Unified Analytic File (UAF) that was used to generate the results presented in this report. The unit of observation of the UAF was either a claims-based episode or an OASIS-based episode.

A.4.1 Analytical Methods for Subtopics

A.4.1.1 Case-Mix

Purpose: To determine if case-mix of beneficiaries receiving home health care have changed over time between HHVBP states and non-HHVBP states.

Data Acquisition: The case-mix analyses used home health episode claims data, OASIS assessment data, and Part B carrier, inpatient and outpatient claims.

Data Processing: We included all HH episodes that occurred between 2013 and 2019, excluding DC and U.S. territories. We defined three measures of case-mix: total normalized composite measure of mobility at the start of care, total normalized composite measure of self-care at the start of care and HCC score (first episode) and examined trends in the mean values of these measures between HHVBP states and non-HHVBP states in the baseline (2013-2015) and post-HHVBP period (2016-2019). We computed yearly and cumulative D-in-D estimates for each of the case-mix measures adjusting for agency characteristics (setting, ownership, HHA age, HHA size, and chain status), state fixed effects and state-specific linear trends in the regression model. Details on how these measures were constructed are given below.

Total Normalized Composite Measures of Mobility and Self-Care at the Start of Care

The OASIS-based case-mix measures used in this analysis were the two composite measures of mobility and self-care at the start of care (previously described in Section A.2.1.1). The sum of start of care responses was treated as a continuous variable for this analysis with values ranging from 0 to 15 for mobility start of care measure and from 0 to 23 for self-care measure.

HCC Score (First Episode)

The claims-based case-mix measure used in this analysis was the episode-level HCC risk scores, calculated for the first episode in the sequence or for the earliest episode during the previous year among sequences that began more than a year ago (previously described in Section A.2.1.2).

A.4.1.2 Causes of Hospitalization

Purpose: To determine the relationship between home health episodes and inpatient hospitalizations

Data Acquisition: Cause of Hospitalization analyses used the inpatient hospitalization claims, the home health episode claims data and MBSF.

Data Processing: We included all first home health episodes that occurred between 2013 and 2019, excluding DC and U.S. territories. We defined home health episodes to have a prior hospitalization if

they had an inpatient hospitalization (both unplanned and planned) 14 days or less prior to the start of the episode. Hospitalizations that occurred on the first day of the home health episode were excluded. Home health episodes that had an acute and unplanned hospitalization within 60 days after the start of the episode were flagged as having a home health hospitalization. Home health episodes were categorized into four groups based on whether they had prior or home health hospitalization:

(a) Home health episodes with no prior hospitalization and no home health hospitalization
(b) Home health episodes with prior hospitalization only
(c) Home health episodes with home health hospitalization only
(d) Home health episodes with both prior hospitalization and home health hospitalization

We calculated the rehospitalization rate from episodes that had a home health hospitalization among all episodes that had a prior hospitalization. The analyses were focused on Medical type Rehospitalization (for definition please see Section A.3.3) and we examined three situations: 1. Episodes without rehospitalization, 2. Episodes that had a hospitalization within 60 days of the home health start date with same Major Diagnostic Categories (MDC) (see section A.3.3 for details) as index Medical hospitalization, 3. Episodes that had a hospitalization within 60 days of the home health start date that were either surgical or with different MDC than that of the index Medical hospitalization.

We further examined hospitalization rates stratified by surgical and medical types and by MDC categories. We selected the top seven MDC categories that accounted for the major part of home health hospitalizations and combined the remaining MDCs into a single group called “Other MDCs”. These seven MDCs include: Diseases and Disorders of the Nervous System, Diseases and Disorders of the Respiratory System, Diseases and Disorders of the Circulatory System, Diseases and Disorders of the Digestive System, Diseases and Disorders of the Musculoskeletal System and Connective Tissue, Diseases and Disorders of the Kidney and Urinary Tract, Infectious and Parasitic Diseases and Disorders (Systemic or unspecified sites).

D-in-D models in our analyses adjusted for all covariates listed in Exhibit A-3, Exhibit A-4 + Medicare Entitlement indicator along with state fixed effects. The model specification was the same as that specified in Section A.1.5.1

A.4.1.3 HHA Operations: Frontloading

Purpose: To determine the frequency, timing, and discipline of home health visits within home health episodes in order to establish potential working definitions of frontloading in the Medicare FFS population. These definitions were then evaluated as outcomes using our standard multivariable D-in-D model (see details below) to estimate the relative impact of the HHVBP Model on agency frontloading practices.

A.2.1.2***Data Acquisition:*** Frontloading analyses were completed using home health visit claims data, home health episode claims data, the institutional claims, and HHA POS data.

Data Processing: Descriptive analyses included all first home health episodes that occurred between 2013 and 2019, excluding DC and U.S. territories and used the home health visits AF (see Section A.2.1.2 to determine average cumulative visits by a skilled nurse or by a therapist (occupational, physical, and speech therapists combined) for three time checkpoints: 7, 14, and 60 days following the start of a home health episode. Average visit counts within a home health episode were stratified by the Arbor-

defined admissions source (community vs. institutional, see section A.2.1.2 above) and HHVBP status. The calculation of average cumulative visits per episode included a numerator of cumulative visits broken out by visit type, aggregated through the end of the episode and a denominator that included the total number of [first] episodes. The 14-day average cumulative skilled nursing and therapy visit counts were restricted to episodes in our difference-in–differences analytic sample.

Further frontloading analyses focused solely on post-institutional episodes. We focused these analyses on episodes that followed from an institutional stay in an acute care hospital (ACH), skilled nursing facility (SNF), inpatient rehabilitation facility (IRF), inpatient psychiatric facility (IPF), or long-term care hospital (LTCH) due to the greater risk such episodes have for subsequent unplanned hospitalizations. Included episodes lasted at least two weeks and did not have an hospitalization in that two week timeframe in order to ensure a "baseline" period of time in which frontloading could occur. We also excluded episodes not linked to an OASIS assessment and episodes with missing values for any model covariates. Both the episode-level counts of either skilled nursing (SN) or therapy visits occurring within the first fourteen days following home health episode start and the proportion of those visits occurring in the first seven of 14 days were examined to create potential working definitions of frontloading for our analyses. Two binary indicator flags were created to signify episodes in which the number of SN visits or the number of therapy visits that occurred in the first week of home health care was greater than the number of visits in the second week for each respective type. Predictive regression analyses were run to examine the association between the count during the first two weeks or indicator that the first week proportion of SN or therapy visits was greater than the second week proportion and clinical outcomes, including ACH and ED use. Frontloading difference-in-differences models contained all covariates included in our main D-in-D models (Exhibit A-3, Exhibit A-4) and also adjusted for the number of ED visits occurring within that two-week time-frame. We adjusted for the number ED visits during the first two weeks of home health care in order to control for potential confounding between ED use that may prohibit some home health visits and also indicate greater likelihood to use the ED after the initial two weeks of care. Statistically significant falsification results, indicating a lack of parallel trends, dictated the inclusion of state linear time trends in the model to reduce bias.

A.4.1.4 Entry and Exit of HHAs

Purpose: To calculate the rates of HHA openings and closures over time.

Data Acquisition: We used POS data (see Section A.3.4). Empirically, there was a data lag in certification and termination dates in CMS POS data beyond the lag for other data sources used in this report. The completion rate of CMS POS data is about 99 percent for participation dates and 93 percent for termination dates, with a one year lag in reporting. Therefore, our HHA entry and exit analyses are reported through Quarter 2 of 2019 (i.e., 12 months from when the data were pulled for this Annual Report) instead of through the end of 2019 as is done for other analyses. See Exhibit C-9. below for the quarterly counts of entering, exiting, and open HHAs in HHVBP and non-HHVBP states for 2013 Q1 through 2019 Q2.

Data Processing: Entry of new HHAs was determined by the HHA certification date in CMS POS data. The HHA entry rate was calculated by dividing the number of HHAs with certification dates in a given quarter divided by the number of HHAs open at any point in a given quarter. Exit of existing HHAs was determined by the HHA termination date in CMS POS data. The HHA exit rate was calculated by dividing

the number of HHAs with termination dates in a given quarter divided by the number of HHAs open at any point in a given quarter (see Section A.2 for measure definitions).

We also calculated periods of inactivity when an HHA is open according to the POS certification and termination date, but the HHA does not have any OASIS or claims-based home health episodes. We observed that these HHAs are often small, in the process of opening or closing, and tend to serve specialized groups of patients such as pediatric patients (who are excluded from OASIS assessments and may not have Medicare coverage). We excluded these inactive HHAs from most of our analyses based on OASIS or claims-based episodes, where HHA counts are determined using the presence of OASIS or claims-based home health episodes in a given year and where home health episodes are the basis of the HHVBP program quality measures. However, we *included* these inactive facilities in the denominator of the HHA entry and exit analyses, which uses CMS POS data to determine the number of open HHAs. Therefore, the HHA counts used in the entry and exit analyses may differ from other analyses that exclude agencies without OASIS or claims-based home health episodes in a given time period.

A.4.1.5 Low/High Performers and Social Risk Factors

Purpose: To examine the association between agency TPS and patient mix based on social risk factors.

Data Acquisition: Agency TPS calculated using QIES roll-up data, POS data, and HHCAHPS data.

Data Processing: We identified 7,821 agencies eligible for TPS based on performance year 2019 (HHVBP: 1,546; Non-HHVBP: 6,275). We then classified agencies into three groups (high, middle, and low performers) based on TPS quartiles by state. The top 25% of agencies was defined as the "higher TPS" cohort, the bottom 25% of agencies was defined as the "lower TPS" cohort, and the middle 50% of agencies was defined as the "middle TPS" cohort. The percentages were 24.9%, 24.8%, and 50.3% for each category, respectively. The distribution was similar in HHVBP and non-HHVBP states.

Below are the definitions used for comparing patient demographics and social risk factors among HHAs that are high/low performers:

- Age greater than 85: proportion of HHA episodes for patients age greater than 85 years
- Black: proportion of HHA episodes for Non-Hispanic black patients
- Hispanic: proportion of HHA episodes for Hispanic patients
- Rural: proportion of HHA episodes for patients living in rural areas
- Dual: proportion of HHA episodes for dual eligible beneficiaries
- Poverty: proportion of HHA episodes for patients living in "high poverty" areas (defined as >=20% poverty in their county of residence)

A.4.1.6 Access to care

Purpose: To examine the extent to which there is geographic variation in FFS beneficiary access to home health care and investigate if HHVBP has affected beneficiary access to home health care.

Data Acquisition: Access to care analyses used the following data sources: MBSF, Medicare FFS claims data including home health, inpatient and outpatient claims, QIES data, and POS data.

Data Processing: We carried out all analyses at the county-year level, using the beneficiary's home address to identify county rather than HHA address. We defined rural and urban counties using CBSA codes as described in Section A.2.1.1.

We determined an HHA was providing service in a county-year if there was evidence on home health claims of at least one FFS home health episode for a beneficiary residing in that county in a given year. Following this logic, a single HHA may have provided service to more than one county if they served beneficiaries residing in different counties. We calculated the percent of Medicare FFS beneficiaries with at least one HHA providing service in their county each year by determining the number of Medicare FFS beneficiaries living in counties where an HHA provided service to at least one Medicare FFS beneficiary and dividing by the total number of Medicare FFS beneficiaries.

In order to identify counties with potential home health access problems we used a combination of factors: evidence of low utilization of home health services using the metric number of home health visits per episode and evidence of poor patient outcomes using the metric of ED utilization without subsequent hospitalization. The average number of visits per FFS home health episode was calculated as the total number of visits per home health episode identified using revenue center codes. ED utilization was calculated as described in Exhibit A-42.

As a method for risk adjustment, we adapted the indirect standardization method used by the AHRQ Quality Indicators[45]. We used the core covariate adjustment described in Exhibit A-3 with the exception of omitting the urban/rural indicator, for two measures: average number of visits per home health episode and ED utilization. We used this method to produce risk adjusted rates at the county-year level for both measures. From 2013-2019, we identified counties in the lowest quintile of risk adjusted average number of visits per FFS home health episode indicating low utilization of home health services each year. Additionally, we identified counties in the highest quintile of risk adjusted ED utilization without subsequent hospitalization indicating high utilization of ED each year. Then, we identified counties that were found to have both low adjusted home health utilization and high adjusted ED utilization as potential low access counties. We performed a sensitivity analysis that additionally included HCC risk score as part of the risk adjustment to avoid potential confounding by home health beneficiary health status and found results to be consistent with the original risk adjustment. We described the prevalence of low home health utilization counties, high ED utilization counties, and low access counties over time stratified by urban/rural location in HHVBP states and non-HHVBP states. Additionally, we compared beneficiary and HHA characteristics between low access counties and other counties in HHVBP and non-HHVBP states.

A.4.1.7 Vulnerable populations

Purpose: To examine potential unintended consequences of HHVBP for more vulnerable populations. Specifically, we assess whether or not the HHVBP program has resulted in widened or reduced disparities in outcomes involving home health beneficiaries enrolled in Medicaid or living in rural areas.

Data Acquisition: Vulnerable population analyses used the same analytical files that were created for the standard D-in-D models for the main comparison group approach of the HHVBP evaluation.

Data Processing: Analyses were carried out at the home health episode level for both the Medicare FFS and OASIS populations with a focus on home health beneficiaries with socioeconomic and geographic characteristics that were associated with poorer outcomes prior to the implementation of HHVBP. Vulnerable populations were defined as (1) home health beneficiaries enrolled in Medicaid and (2)

[45] See description on pages 31 – 32 [Section F.4.3 – F.4.4] of the QI Empirical Methods Report. Available here.

home health beneficiaries in rural areas (based on county of residence). These subgroups were compared to non-Medicaid and urban county of residence reference groups, respectively. Analyses restricted to the Medicare FFS population compared home health beneficiaries dually enrolled in Medicaid and Medicare FFS to the rest of the Medicare FFS home health beneficiaries.

We examined potential disparities prior to the implementation of HHVBP (2013 – 2015) by Medicaid status and rural versus urban location using linear regression models with HHA clustered standard errors and covariate adjustments for beneficiary and agency characteristics (see Exhibit A-3) also used as covariates in the standard D-in-D models for the main comparison group approach. We additionally included adjustments for state Medicaid expansion, interactions of Hispanic ethnicity with post-institutional care, and HCC score (for claims-based outcomes). We also used adjustments for CBSA fixed effects, in place of state fixed effects, for Medicare spending to account for regional differences in cost.

We used an extension of the standard D-in-D model to examine the differential impact of HHVBP by HH beneficiary subgroup on a selective set of five measures. These included two FFS claims-based HHVBP utilization measures (unplanned acute care hospitalization/first FFS HH episodes and outpatient ED use (no hospitalization)/first FFS HH episodes), one FFS-claims based spending measure (average Medicare spending per day during and following FFS home health episodes of care) and two OASIS-based improvement in functional status measures (Total Normalized Composite (TNC) change in self-care and Total Normalized Composite (TNC) change in mobility). The difference-in-difference-in-differences (D-in-D-in-D) approach (as described below) tests for differences in subgroup D-in-Ds by including two- and three-way interactions for treatment, post-HHVBP, and subgroup while using the same covariate adjustments in the baseline models along with interactions for Medicaid and post-institutional care (except for rural vs. urban subgroup comparisons). Using the same model, we are able to simultaneously test for the effect of HHVBP within the individual subgroups.

A.4.1.8 Difference-in-Difference-in-Differences Model

The Difference-in-Differences model enables estimation of overall treatment effect of the HHVBP by comparing changes in observations in the HHVBP states to those in the non-HHVBP states. An extension of this model enables subgroup analyses to assess whether the effect of the HHVBP differs (is heterogeneous) among groups. A D-in-D analysis is fit within a subgroup, that is, the changes in impact measures observed over time within the subgroup in the HHVBP states is compared to corresponding changes in the same subgroup in the non-HHVBP states. Mathematically, we have

$$D\text{-}in\text{-}D_{SG} = [Y_{INT,POST,SG} - Y_{INT,PRE,SG}] - [Y_{COMP,POST,SG} - Y_{COMP,PRE,SG}].$$

Note that this expression is the same as the overall D-in-D model with the subscript "SG" indicating subgroup. A D-in-D model fit for the reference subgroup yields

$$D\text{-}in\text{-}D_{Ref} = [Y_{INT,POST,Ref} - Y_{INT,PRE,Ref}] - [Y_{COMP,POST,Ref} - Y_{COMP,PRE,Ref}],$$

with the subscript "Ref" indicating the reference subgroup.

The subgroup D-in-D model is then contrasted with the reference subgroup D-in-D:

$$D\text{-}in\text{-}D_{SG} - D\text{-}in\text{-}D_{Ref} = \{[Y_{INT,POST,SG} - Y_{INT,PRE,SG}] - [Y_{COMP,POST,SG} - Y_{COMP,PRE,SG}]\} - \{[Y_{INT,POST,Ref} - Y_{INT,PRE,Ref}] - [Y_{COMP,POST,Ref} - Y_{COMP,PRE,Ref}]\}.$$

This is the difference in two D-in-D estimates, the difference in difference in differences (D-in-D-in-D). It estimates the effect of the intervention on a subgroup of interest over and above the general effect of the intervention. Mathematically, it is represented by a three-way interaction between indicators of treatment, post-intervention, and subgroup membership. The associated D-in-D-in-D model also includes the two-way interactions among pairs of subgroup, intervention, and post-intervention indicators as well as the main effect of subgroup membership. Building on the D-in-D model presented earlier, the D-in-D-in-D model for this analysis is

$$Y_{i,p,t} = \alpha_0 + \alpha_1 Treat_i + \sum_{k=1}^{k=4} \beta_k I(t = t_k) + \lambda_0 I_d(p) + \sum_{k=1}^{k=4} \delta_k Treat_i * I(t = t_k) + \varphi_0 I_d(p) Treat_i + \sum_{k=1}^{k=4} \lambda_k I_d(p) * I(t = t_k) + \sum_{k=1}^{k=4} \varphi_k I_d(p) Treat_i * I(t = t_k) + \sum_{j=1}^{j=3} \rho_j I(q = j) + \sum_{s=3}^{s=50} \theta_s I(S = s) + \sum_{s=1}^{s=50} \gamma_s time * I(S = s) + \omega \mathrm{P}_{Cov} + \epsilon_{i,p,t}.$$

where k = 1 to 4 for years 2016-2019. Additionally:

- $Treat_i$: 1, 0 indicator (1= HHVBP states, 0= Non-HHVBP states)
- $I_d(p)$: 1, 0 indicator (= 1 if episode p belongs to the subgroup, 0 otherwise)
- $I(t = t_1)$: 1 , 0 indicator (1 when year = 2016, 0 otherwise)
- $I(t = t_2)$: 1 , 0 indicator (1 when year = 2017, 0 otherwise)
- $I(t = t_3)$: 1 , 0 indicator (1 when year = 2018, 0 otherwise)
- $I(t = t_4)$: 1 , 0 indicator (1 when year = 2019, 0 otherwise)
- α_0 is an intercept
- α_1 is the average difference between the HHVBP and comparison populations over the pre-implementation period
- β_k is the average change from pre- to post-implementation for the HHVBP population in a given year, where *k* = 1 for year 2016, *k* = 2 for year 2017, *k* = 3 for year 2018 and k = 4 for year 2019
- δ_k is the yearly D-in-D effect, for *k* = 1, 2, 3, 4; the difference in the change from pre-implementation to post-implementation for the HHVBP population relative to the comparison population (i.e., to estimate the treatment effect of HHVBP)
- λ_0 is the main effect of belonging in the subgroup , the average difference between belonging to the subgroup vs. not over the pre-implementation period
- λ_k is the average change from pre- to post-implementation in a given year for the subgroup population, where *k* = 1 for year 2016, *k* = 2 for year 2017, *k* = 3 for year 2018 and k = 4 for year 2019.
- φ_0 is the average difference between the subgroup in the HHVBP states and the subgroup in the comparison states during the pre-implementation period (i.e. the interaction effect of subgroup and HHVBP status).
- φ_k is the yearly D-in-D-in-D effect for years indexed by *k*; the difference-in-difference-in-differences estimates from pre-implementation to post-implementation for the HHVP population relative to the comparison population between belonging to a subgroup vs. not (i.e., the subgroup effect)

- ρ_j coefficients capture seasonal effects associated with the four quarters of the year, where *j* = 1, 2, 3 (one quarter omitted as reference)
- ω is a vector of coefficients associated with vector of covariates $\mathbf{P}_{Cov}$
- $I(S = s)$: 1, 0 indicator (1 when from state *s*, 0 otherwise); two states omitted as reference since "treat" is also included in the model
- θ_s coefficients are fixed effects for each state *s*
- $time$: linear term ranging from 2013-2019
- γ_s: coefficients associated with state-specific linear trends, time trends for each state interacted with fixed effects indicator for each state *s*
- $\epsilon_{i,p,t}$ episode-specific error term.

We evaluated the treatment effect of the HHVBP within a given subgroup, comparing the response in the subgroup in the treatment group to that of the same subgroup in comparison group using a Difference-in-Differences framework. We then tested the subgroup D-in-D estimates forming the Difference-in-Difference-in-Differences model. Illustrating with an example, with duals being a subgroup we first calculate a D-in-D estimate of the measure for duals and non-duals respectively. Then we calculate the difference in the subgroup D-in-D estimates resulting in the D-in-D-in-D estimate.

As with the D-in-D model, we included three estimates (ρ_1, ρ_2, ρ_3) capturing quarterly effects. Again, each episode was given an equal weight except for the four average Medicare spending per day measures, which were appropriately weighted by the number of days included in the denominator (see Section A.2.2). In order to obtain the average annual (cumulative) impact estimate over the four HHVBP Model years (i.e. 2016 – 2019), we calculated a linear combination of the three year-specific impact estimates with each year's impact weighted by the number of HHVBP episodes in that year, or in the case of the spending measures, weighted by the sum of denominator days in HHVBP states for the year.

Also consistent with the D-in-D model, standard errors were clustered at the agency-level. Also in this model we stratified at the state level to account for greater homogeneity within states than across states.

Estimations for various effects appear in Exhibit A-62. Note that the effects in the "Subgroup (Indicator = No)" section correspond to those presented for the simple D-in-D model in Exhibit A-6. The yearly D-in-D estimators are given by the coefficients δ_i, I = 1, 2, 3 and 4. The D-in-D-in-D coefficient, φ_k indicates whether the between-intervention group differences for the subgroup of interest, increased ($\varphi_k > 0, k = 1, 2, 3, 4$) or decreased ($\varphi_k < 0, k = 1, 2, 3, 4$) after implementation of HHVBP.

Exhibit A-62. Difference-in-Difference-in-Differences Estimators for Individual Post-Implementation Years

Subgroup	Intervention Group	Pre-Implementation	Post-Implementation	Pre-Post Difference
Yearly Estimators, i =1, 2, 3 and 4 for 2016, 2017, 2018 and 2019 respectively				
Subgroup (Indicator = NO)	HHVBP	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \beta_i + \delta_i$	$\beta_i + \delta_i$
	Non HHVBP	α_0	$\alpha_0 + \beta_i$	β_i
	Between intervention groups within subgroup (D in-D estimate for this subgroup)	α_1	$\alpha_1 + \delta_i$	δ_i
Subgroup (Indicator = YES)	HHVBP	$\alpha_0 + \alpha_1 + \lambda_0 + \varphi_0$	$\alpha_0 + \alpha_1 + \beta_i + \lambda_0 + \varphi_0 + \delta_i + \lambda_i + \varphi_i$	$\beta_i + \delta_i + \lambda_i + \varphi_i$
	Non HHVBP	$\alpha_0 + \lambda_0$	$\alpha_0 + \beta_i + \lambda_0 + \lambda_i$	$\beta_i + \lambda_i$
	Between intervention groups within subgroup (D in-D estimate for this subgroup)	$\alpha_1 + \varphi_0$	$\alpha_1 + \delta_i + \varphi_0 + \varphi_i$	$\delta_i + \varphi_i$
	Between subgroups (D-in-D-in-D)	φ_0	$\varphi_0 + \varphi_i$	φ_i

As with the D-in-D model, we calculate the cumulative estimate as the weighted average of the yearly estimates to ensure that the cumulative estimate is consistent with the yearly D-in-D estimates. We calculated the weights for each of the measure domains as follows:

- For the claims-based utilization measures - the proportion of claims episodes in each year
- For the claims-based Medicare spending measures - the proportion of days in each year
- For OASIS-based outcome measures – the proportion of OASIS episodes in each year

A.4.1.9 Substitution among Post-Acute Care Alternatives

Purpose: To examine changes in use of alternative forms of post-acute care following the HHVBP Model implementation, which may be considered substitutes for home health care. The alternative forms of post-acute care include skilled nursing facilities, inpatient rehabilitation facilities, and those discharged to home with no post-acute care or only outpatient therapy service.

Data Acquisition: Substitution of care analyses used the following data sources: Medicare FFS inpatient hospitalization, outpatient, HHA, and SNF claims, the MBSF, and the AHRF.

Data Processing: Analyses were carried out at the index discharge level. An analytic file was constructed using inpatient claims for all Medicare FFS beneficiaries with a short-term acute hospital discharge during 2013-2019. The analytic sample was restricted to beneficiaries based on the following criteria: (1) enrollment in Medicare FFS Parts A and B during 12 consecutive months prior to the index discharge date; (2) alive at discharge with continued enrollment in FFS Parts A and B for at least 14 days

following the index discharge date; (3) the DRG reported on the index discharge inpatient claim was among the top 10 Major Diagnostic Categories (MDCs) among beneficiaries who are discharged to the care of an HHA.

Next, we looked out 14 days from each index discharge date for Medicare FFS claims from HHAs, IRFs, SNFs, and hospital outpatient therapy care (i.e. physical therapy [revenue center code 0420:0429], occupational therapy [revenue center code 0430:0439], or speech language pathology [0440:0449]) provided to the same FFS beneficiary. Post-acute care type for each index discharge was then defined based on the earliest claim from date within 14 days of the discharge date. Home health was additionally defined as the post-acute care type in the event that an earlier home health episode for the same beneficiary overlapped the index discharge date with no other claims from alternate forms of post-acute care found within 14 days of discharge.

The distribution of PAC types was then calculated separately for HHVBP states and non-HHVBP states during the pre- (2013-2015), early post- (2016-2017), and late post-(2018-2019) implementation periods. We used linear regression models with D-in-D to estimate the effect of HHVBP on the selection of PAC type (each defined as a binary indicator) clustering for hospital provider and adjusting for state linear trends and covariates that were not sufficiently balanced between groups during baseline (2013-2015) including patient age, rural beneficiary residence, and ACO SSP and Pioneer APM indicators.

A.4.1.10 Change in Functional Status Reported on OASIS Start of Care (SOC) Assessment

Defining the Study Population: The sample for the analysis of functional status at SOC was drawn from Medicare FFS beneficiaries with a home health episode beginning between 2013 and 2019. Episodes were included if the beneficiary was admitted to home health care within 14 days of discharge from an inpatient hospital stay; had no other post-acute care in the intervening time period; had matching home health episode start dates on the SOC OASIS assessment and the Medicare FFS claim; and the respective SOC OASIS assessment was conducted within the required five days of the home health episode start date. To reduce the influence of confounding factors and improve clinical homogeneity among beneficiaries, we conducted our analyses within three cohorts defined by the primary diagnosis associated with the inpatient admission stay that preceded the home health episode:

- Pneumonia (n = 331,809 home health episodes)
- Heart failure (n=564,844 home health episodes)
- Hip/knee replacement (n=915,217 home health episodes)

These diagnoses are all highly prevalent in the Medicare FFS population and include beneficiary populations with diverse characteristics. In addition, because these diagnoses have ICD-9 to ICD-10 conversion defined by the readmission measures in the Hospital Readmission Reduction Program (HRRP), there was consistency before and after the transition from ICD-9 to ICD-10 coding in 2015.

Defining Lower and Higher Functioning among the OASIS Measures of Interest: We selected the three OASIS measures that examine improvement in ambulation, dyspnea and grooming measures from the larger set of OASIS measures to capture different aspects of functional status and explore whether there was variation in the observed trends depending on the following characteristics of the measures:

- Inclusion in the TPS: Since 2019, Improvement in Ambulation/Locomotion and Improvement in Grooming have entered the TPS through the Total Normalized Composite Change in Mobility and the Total Normalized Composite Change in Self Care respectively. Prior to 2019, Improvement in Grooming was not part of the calculation of the TPS, while Improvement in Ambulation/Locomotion was a separate quality measure in TPS. Improvement in Dyspnea has been used directly in the calculation of the TPS since the beginning of the HHVBP Model.
- Number of response categories: 7 for ambulation, 5 for dyspnea, and 4 for grooming
- Publicly reported on CMS' Home Health Compare website: Improvement in Ambulation and Improvement in Dyspnea are included; Improvement in Grooming is not.

To facilitate interpretation, we constructed dichotomous variables for each measure, collapsing the multiple response categories into "higher functioning" and "lower functioning" categories. Because each measure differs in the number of response categories, the definitions for "higher functioning" and "lower functioning" were defined independently for each measure. We defined "higher functioning" categories as those measure categories that had the highest combined *decrease* in the share of SOC assessments between the pre- and post-HHVBP periods, and defined "lower functioning" categories as those measure categories that had the highest combined *increase* in the share of SOC assessments between the pre- and post-HHVBP periods. The main outcome in our analysis was the share of assessments in which one of the "less functional" categories was recorded for the three OASIS measures of interest. Exhibit A-63 lists the covariates we used in our multivariate regression model to predict functional status at SOC in the two post-HHVBP periods (i.e., 2016-2017; 2018-2019).

Exhibit A-63. Covariates used in regression model to predict functional status at SOC

Variable*
Beneficiary characteristics
State
Age group (18-44, 45-64, 65-74, 75-84, 85-94, 95 and older)
Sex
Original entitlement reason for Medicare (disabled and/or ESRD, not disabled and not ESRD)
Characteristics of the IP stay
MS-DRG weight (5 categories based on quintiles for 2013-2015)
Length of stay (1 or 2 days, 3 to 5, 6 to 10, 11 to 14, 15 and longer)
Period between IP stay and HH episode
Number of days between IP discharge and start of HH episode (0 or 1 days, 2 or 3, 6 to 14)
ER visit between IP stay and HH episode Y/N
Risk Factors Reported on OASIS SOC assessment
History of falls
Urinary incontinence
Taking more than 5 medications

Variable*
Month at SOC (1-12 categories, corresponding to month of the year)
Health Status Reported on SOC OASIS Assessment
HCC score at SOC (10 categories based on deciles for 2013-2015)
Health Conditions Reported on MBSF
Alzheimer
Anemia
Cancer
Congestive heart failure
Chronic kidney disease
COPD
Diabetes
Ischemic heart disease
Rheumatoid Arthritis/Osteoarthritis
Ulcers
Liver disease

** See Section A.2.1.1 for additional detail for these beneficiary characteristics.*

A.4.2 Claims-Based Episodes

For observations that represent a claims-based home health episode, the data set provided claims-based episode information (e.g., episode type, therapy visits), HHA information, claims-based measures, MBSF-based beneficiary enrollment and chronic condition data, linked OASIS-based episode information (e.g., start date, end date, OASIS assessment ID), and OASIS assessment information (e.g., demographics, payment, inpatient diagnosis, timing). OASIS information was extracted from the overlapping OASIS-based episode with the earliest episode start date; the rationale behind this was that claims-based episodes were included in claims-based measure denominators based on episode start date, and our goal was to include OASIS information corresponding to the same measurement period.

A.4.3 OASIS-Based Episodes

For observations that represent an OASIS-based home health episode, the data set provided OASIS-based episode information (e.g., start date, end date, OASIS assessment ID), OASIS-based measures, OASIS assessment information (e.g., demographics, payment, inpatient diagnosis, timing), MBSF-based beneficiary enrollment and chronic condition data, linked claims-based episode information (e.g., episode type, therapy visits), and HHA information. Claim information was extracted from the overlapping claims-based episode with the latest episode start date; the rationale behind this was that OASIS-based episodes were included in OASIS-based measure denominators based on episode end date, and our goal was to include claims-based information corresponding to the same measurement period.

A.4.4 Construction of Unified File

The unification of the claims-based and OASIS-based home health episodes began with compiling the base data sources: claims-based episodes, OASIS-based episodes, and OASIS assessment-level data. For claims-based episodes, we maintained all episodes that began on or before 12/31/2019 and ended on or

after 01/01/2013. For OASIS-based episodes of care, we maintained all episodes with an end date from 2013 through 2019, including those with end reason for assessment equal to "Death" although these episodes were excluded from the HHVBP OASIS outcome measures. We maintained all OASIS assessments that were pulled from the CCW Oracle database, which covers assessments effective from 2009 through 2019; this ensured that we had all available assessments that could potentially be linked to a claims- or OASIS-based episode during our measurement period. Among these assessment-level records, we kept only the variables of interest to analyses in the Annual Report (see Section A.2.1.1 for list of variables pulled from OASIS assessments). Note that for OASIS-based data, the CCW beneficiary identifier was not always populated, presumably for a variety of reasons related to the beneficiary matching process and the wider scope of insurance coverage among OASIS beneficiaries (e.g. Medicare FFS, Medicare Advantage, Medicare and Medicaid, Medicaid only). For these episodes/assessments, we were unable to link to the CCW-based Medicare claims and enrollment data.

After compiling the basic data sources, we further processed the OASIS-based episodes to ensure there were no overlaps between episodes for the same patient (occurs for approximately 0.1% of all OASIS-based episodes). First, we removed any OASIS-based episodes that began and ended within a longer OASIS-based episode for the same patient. For example, if a patient had an OASIS-based episode that began on 01/01/2013 and ended on 12/31/2014, and also a shorter episode beginning on 12/23/2013 and ending on 12/26/2013, then the shorter episode beginning on 12/23/2013 would be excluded from further analyses. Second, if multiple OASIS-based episodes for the same patient overlapped in time, but did not meet previously defined exclusion criteria, then we truncated the end of the preceding episode so that the episode ended one day prior to the ensuing episode start date. Although each of these overlapped OASIS-based episodes may be included in HHVBP measure calculation individually, their overlapping nature are problematic when trying to link the OASIS-based episodes of care to their constituent claims-based episodes.

Next, we merged the claims-based episodes and OASIS-based episodes described in the preceding paragraphs based on CCW beneficiary ID and whether the episodes overlap in time. As a result, there could be 0, 1, or multiple OASIS-based episodes that link to one claims-based episode; likewise, there could be 0, 1, or multiple claims-based episodes that link to one OASIS-based episode. In the case, for example, when an OASIS-based episode overlapped with multiple claims-based episodes, the OASIS-based episode would be represented by a record for each of the overlapping claims-based episodes. If, for example, an OASIS-based episode does not link to any claims-based episodes, that OASIS-based episode would be represented by only one observation. Repeated observations for a particular episode, claims-based or OASIS-based, was de-duplicated in a later step.

For the purposes of assigning OASIS assessment data to each resulting linked episode, the set of episodes were conceptually categorized as follows: 1) claims-based episodes that overlap with at least one OASIS-based episode for the same beneficiary and ending prior to 01/01/2015; 2) claims-based episodes that overlap with at least one OASIS-based episode for the same beneficiary and ending on or after 01/01/2015; 3) claims-based episodes that do not overlap with an OASIS-based episode for the same beneficiary; 4) OASIS-based episodes that ended prior to 01/01/2015; and 5) OASIS-based episodes that ended on or after 01/01/2015. OASIS-based episodes were divided into groups based on episode end date due to an issue in the source assessment data, in which the assessment identifier for assessments effective prior to 2015 was not linkable to the assessment identifier provided in the QIES-based OASIS episode-level data. For these cases, there was a suitable alternative for linking the two

sources (described below), although not as accurate as linking by the assessment identifier itself. For assessments effective on or after 2015, the assessment identifier was consistent with the assessment identifier provided in the OASIS episode-level data, which meant these assessments were directly linkable to their corresponding episodes.

For episodes belonging to categories 1 and 4, the associated OASIS-based episode was linked to start and end OASIS assessments by matching on the following data elements: QIES state identifier, QIES resident identifier (uniquely identifies a patient when combined with state identifier), assessment effective date corresponding to OASIS episode start and end dates, assessment reason, and QIES provider identifier. For episodes belonging to categories 2 and 5, the associated OASIS-based episode was linked to an OASIS assessment by matching directly on the assessment identifier for the assessments corresponding to the start and end of the OASIS-based episode. For episodes belonging to category 3, we used assessment data elements derived from the claim treatment authorization code[46] submitted with each home health claim to link to the OASIS assessment submitted at the beginning of the claims-based episode of care. Because this linked assessment does not always represent a SOC/ROC, the next step was to trace back to the most recent SOC/ROC assessment previously submitted for that beneficiary, if possible. The goal of getting the assessment associated with the SOC/ROC was desirable because these assessment types required completion of more assessment items, as opposed to re-certification assessments (for example) which required fewer items to be completed.

The next step was to ensure that each record in the UAF uniquely represented a home health episode, whether sourced from claims or OASIS. For claims-based episodes that linked to multiple OASIS-based episodes, we only maintained the claims-based episode record that linked to the earliest OASIS-based episode based on start date. For OASIS-based episodes that linked to multiple claims-based episodes, we only maintained the OASIS-based episode record that linked to the latest claims-based episode based on start date. Episodes that linked to zero or one episode were also maintained in the data set as one record per episode. Thus, the resulting file contained one record for each claims- and OASIS-based episode occurring during the measurement period, where the vast majority of episodes had been linked to OASIS data based on previously described logic. Each episode's data source (claims vs. OASIS) was distinguished by a source indicator variable. The CY and quarter to which an episode was assigned was based on the episode start date for claims-based episodes, while for OASIS-based episodes, it was based on episode end date.

For each episode in the data set, we determined both the county in which care was provided (i.e. county of beneficiary residence) and also the state in which the HHA operates. For OASIS-based episodes and claims-based episodes that could be linked to an OASIS assessment, the beneficiary county was derived from the ZIP code reported on the start of care OASIS assessment. If beneficiary ZIP code was invalid or not available from a linked OASIS assessment and the episode is claims-based, then we used the ZIP code provided on the home health claim. If the ZIP code was invalid or unavailable on the linked OASIS assessment and home health claim, then we used the HHA's ZIP code as provided on the POS data set. The resulting ZIP code was mapped to one or more counties using the U.S. Department of Housing and Urban Development (HUD) ZIP-to-county crosswalk file. For cases where the ZIP code overlapped multiple counties, we selected the county that contained the largest proportion of the ZIP code

[46] For more information on treatment authorization code, see p. 54-55 of CMS Medicare Claims Processing Manual, Chapter 10. Available here.

population. For claims-based episodes that still did not have an associated county of beneficiary residence, we went through hierarchical logic spanning several data sources to determine the beneficiary residence at the time of the claims-based episode. This process is described in detail below in Section A.4.4.1. In order to determine the state in which an HHA operates, we used the first two digits of the HHA's CCN and referred to the current CMS CCN documentation.[47]

With the basic units of observation established, the rest of the UAF construction process involved adding data elements from various sources. The list below provides each of the data sources and a brief description of the associated data elements that were added to the UAF. For more detail on each of the data elements as they were incorporated in analyses, see Section A.3.

- Monthly Medicare FFS and dual eligibility indicators derived from the MBSF Base segment data; merged onto the UAF by beneficiary identifier and month
- Beneficiary enrollment and demographic data from the MBSF Base segment data; merged onto the UAF by beneficiary identifier and year
- Beneficiary chronic condition indicator variables derived from the MBSF Chronic Conditions segments data; merged onto the UAF by beneficiary identifier and year
- Various HHA-year level characteristics (e.g. chain affiliation, ownership type, count of episodes in year, etc.) sourced from POS data, PECOS and Cost Report data, and OASIS process measure data; merged onto the UAF by HHA CCN and year
- Home health claim-based data elements, either directly pulled from or derived from claim header and line item data; merged onto the UAF for only claims-based episodes using the CCW claim identifier
- OASIS-based episode-level outcome measure predicted probability and measure inclusion flags; merged onto the UAF for only OASIS-based episodes based on OASIS-based episode identifier
- Claims-based episode-level impact measure predicted probability and measure inclusion flags; merged onto the UAF for only claims-based episodes based on beneficiary identifier and episode start date
- OASIS process measure data received at the HHA-month level, but aggregated to the HHA-quarter level using an average weighted by episode count; merged onto the UAF based on HHA CCN and quarter
- County-level AHRF variables; merged onto the UAF based on beneficiary county of residence. See preceding two paragraphs in this section for information regarding how beneficiary county of residence was determined, as well as Section A.4.4.1 below for details on how that information was supplemented.
- The total number of Medicare eligible FFS beneficiaries are merged onto the UAF based on quarter in which the episode occurs (as defined by end date for OASIS episodes of care and start date for claims-based episodes) and beneficiary county of residence. See preceding two paragraphs in this section for information regarding how beneficiary county of residence was determined, as well as Section A.4.4.1 below for details on how that information was supplemented.

[47] See CMS Manual System Pub 100-07 State Operations Provider Certification - 2779A1. Available here.

- Prior care setting indicator variables based on the 30 days prior to each episode; merged onto the UAF by episode identifier for all claims-based episodes and for OASIS-based episodes in which the beneficiary was full FFS enrolled for the entire 30-day lookback period
- OASIS-assessment items used for risk factor calculations; merged onto the UAF based on the linked OASIS assessment identifier for both the assessment that starts an episode and the assessment that ends an episode

Finally, we excluded all records in which the patient was treated by an HHA that operates in one of the U.S. territories or the District of Columbia (as determined by first two digits of CCN). The resulting UAF was used for all analysis reported in this report.

A.4.4.1 Identifying Beneficiary County of Residence

To supplement OASIS-based beneficiary ZIP code information used to determine county of residence, we constructed a process for identifying the county in which each home health claims-based episode occurred (i.e., beneficiary residence). The CBSA where services were provided is a claim line item, indicated by value code 61; in our analyses, this is considered the most reliable source of service location. However, in the case where the beneficiary lives in a rural area (outside of a CBSA), the line item only indicates the state of service; further, many CBSAs included multiple counties. To address these situations while still leveraging the accuracy of the CBSA for determining location of service, we followed a multi-step approach for determining the county in which services were provided during a home health episode:

1. Using the National Bureau of Economic Research's CBSA to Federal Information Processing Standards county crosswalk file, we mapped any valid CBSA code to one or more of its associated counties.
    a. If a non-rural CBSA mapped to one valid county, then the episode was associated with that county in analyses.
    b. If the line item indicated a rural area (i.e., no valid CBSA), or if the CBSA did not map to a single valid Federal Information Processing Standards county code, then we proceeded to the next step.
2. We next used patient ZIP code on the OASIS assessment nearest to the claims-based episode start date to determine the county where home health services were provided. We included any OASIS assessment within 90 days of the claims-based episode start date.
    a. For the selected OASIS assessment, we used the HUD ZIP to county crosswalk to map the county of service. For instances when the CBSA from Step 1 mapped to multiple counties, we ensured that the county derived from the OASIS assessment ZIP code matched one of the counties within the CBSA.
    b. For instances when the episode of care was provided in a rural area, we ensured that the county derived from the OASIS assessment ZIP code existed in the same state that was indicated by the claim line item value.
    c. If there were no OASIS assessments for the beneficiary within 90 days of the claims-based episode start date, *or* the county derived from the OASIS ZIP code did not align with the CBSA or rural area's state, then we proceeded to the next step.
3. Next, we examined the monthly beneficiary county of residence data from the MBSF for the month in which the claims-based episode ended.

   a. If the CBSA from Step 1 mapped to multiple counties, we maintained the county from the MBSF if it matched one of the counties within the CBSA.
   b. If services were provided in a rural area, we maintained the county from the MBSF provided that the corresponding state matched the state of the rural area.
   c. Otherwise, we proceeded to the next step.
4. We next examined the mailing address county associated with the home health claim. We applied the same logic as described in Step 3, but maintained the county from the claim (vs. MBSF).
5. Next, we examined the MBSF monthly beneficiary county of residence data, but expanded our search from Step 3 to include the 3 months preceding and following the month in which the home health episode ended. We applied the same logic as described in Step 3, giving higher priority to counties from months that were closer to and preceding the month in which the home health episode ended (e.g., 1 month before takes precedence over 2 months before, and also takes precedence over 1 month after). If none of the 6 months evaluated yielded a county that aligns with the CBSA or rural area, we proceeded to the next step.
6. Next, we examined the ZIP in which the HHA is located, sourced from the CCW's HHA facility files. Using the HUD ZIP code to county crosswalk file (as in Step 2), we mapped the associated county in which the HHA is located.
   a. If the CBSA from Step 1 mapped to multiple counties, then we assigned the HHA's county to the episode only if it matched one of the counties within the CBSA.
   b. If services were provided in a rural area, then we assigned the HHA's county to the episode only if the corresponding state matched the state of the rural area.
   c. Otherwise, we proceeded to the final step to determine the county in which services were provided.
7. Finally, to account for any remaining episodes that had not yet been assigned a county through this multi-step process (<10% of total episodes), we repeated Steps 2 through Step 5, but *without* enforcing that the county align with the CBSA or rural area state found on the claim.

A.5 Glossary

Term	Definition
Claims-Based Episode of Care	Standard episode of HH care as defined by Medicare claims data. Each episode is 60 days or less and defined by CLM_FROM_DT and CLM_THRU_DT reported on the claim.
PEP	Claims-based episodes subject to a Partial Episode Payment (PEP) are identified by patient discharge status code in the HH claims RIFs (PTNT_DSCHRG_STUS_CD) equal to 06.
LUPA	Claims-based episodes subject to a Low Utilization Payment Adjustment (LUPA) are identified by the LUPA indicator variable (CLM_HHA_LUPA_IND_CD) in the HH claims RIFs.
OASIS-Based Episode of Care	Standard episode of HH care as defined by OASIS assessments. Unlike claims-based episodes, OASIS episodes do not have time limits and can span years. Episode start is defined by the effective date of the SOC/ROC assessment that begins an episode. Episode end is defined by the effective date of the assessment indicating patient discharge, admission to inpatient facility, or death.
Outlier	Outlier payment adjustments are made for claims-based episodes representing a relatively high utilization of HH services. Episodes subject to an outlier payment are identified by the presence of a claim line value code (CLM_VAL_CD) equal to 17 in the HH claims RIFs.
MDC	Major Diagnostic Categories (MDC), which are formed by dividing all possible principal diagnoses (from MS-DRG) into 26 mutually exclusive diagnosis areas largely corresponding to a single organ system.
Normal	A claims-based episode is considered normal if it did not receive a PEP, LUPA, or outlier payment adjustment.
FFS	A beneficiary is considered full FFS for a given month if they are enrolled in Medicare Parts A and B and are not receiving HMO coverage, based on MBSF monthly enrollment indicators.
Home Health Stay	A home health stay is a sequence of home health payment episodes separated from other home health payment episodes by at least 60 days. [22]
POS	Provider of Services (POS). Files can be downloaded from CMS website: https://www.cms.gov/Research-Statistics-Data-and-Systems/Downloadable-Public-Use-Files/Provider-of-Services/index
Predicted Probabilities	Episode-level values indicating the probability that the episode is included in the measure numerator, based on the measure-specific risk adjustment model.
Sequence of Episodes	Multiple claims-based episodes for the same beneficiary in which the subsequent episode starts within 60 days of the previous episode end date are considered to be part of the same episode sequence.
Sequence Start Date	Date on which the first episode in a sequence of claims-based episodes starts.
Sequence End Date	Date on which the last episode in a sequence of claims-based episodes ends.
Transfer HHAs within 60 Days	If a beneficiary has multiple claims-based episodes for different HHAs in which one episode starts within 60 days of the previous episode, the first episode is flagged to indicate a transfer of HHAs within 60 days. These flagged episodes are excluded from the denominator of several measures in this report.
VRDC	CMS offers a secure way of accessing its program data through virtual access to the CMS Virtual Research Data Center (VRDC). The CMS VRDC is a virtual research environment that provides timelier access to Medicare and Medicaid program data in a more efficient and cost effective manner. Researchers working in the CMS VRDC will have direct access to approved data files and be able to conduct their analysis within the CMS secure environment.

Appendix B: Qualitative Technical Appendix

B.1 Home Health Agency Interviews

We conducted 63 interviews with key informants from HHAs across the nine HHVBP states between July and September of 2020. To provide a longitudinal perspective on the impact of the model on HHA operations, we targeted the 67 agencies originally interviewed in 2017. As in 2017, we allocated interview slots across the nine intervention states attempting to approximately reflect the proportion of HHAs in each state, while still allowing sufficient interviews in each state to adequately understand any state-specific issues. We describe the deliberative sampling of agencies across several key characteristics, as well as the data collection and analyses conducted below.

While these qualitative interview data are not representative of all HHVBP HHAs, the diversity of agency characteristics and geographies reflected in this sample, comparable with that of 2017, offers a picture of the issues and factors likely impacting the broader agency population, provides a real-world context for interpreting quantitative evaluation results, and identifies hypotheses for future data collection activities and analyses.

B.1.1 HHA Interview Allocation and Outreach

The research team interviewed two thirds (n=44) of the 67 HHAs interviewed in 2017 in 2020. To ensure as consistent a sample as possible between 2017 and 2020, when an agency interviewed in 2017 was unable or unwilling to participate in an interview in 2020, the evaluation team identified an alternative agency interviewed in 2018 within the same state. In addition, we sought an agency interviewed in 2018 that was comparable with the following variables to the extent possible: ownership type, facility type, size, and chain affiliation. Approximately half (n=19) of the 2018 replacements contacted agreed to participate in interviews.

Several factors prevented exact replication of the 2017 sample. First, about one-third of the agencies (23 HHAs) interviewed in 2017 declined to be interviewed or failed to respond to multiple outreach attempts from the interview team, so were not included in the 2020 cohort. At least two agencies interviewed in 2017 were no longer in operation in 2020. It is possible that other agencies that did not respond to outreach also closed. Second, a number of other agencies maintained the same provider numbers but had changed ownership. Third, we excluded three of the 2017 HHAs interviewed from the 2020 sample because they were interviewed in the past year, and we did not want to place unnecessary burden on those agencies. In the majority of the interviews, we spoke with the same individual(s) interviewed in 2017 or 2018.

Overall, the 2020 sample was reflective of the sample characteristics of agencies interviewed in 2017 (state, ownership type, chain status, facility type and size), as illustrated in Exhibit B-1 below. The similarity and considerable overlap between the two samples enabled us to make a fair comparison of changes over time. Changes in ownership in the interim contributed to changes in the proportions of for-profit, non-profit, and government-owned agencies reflected in the 2020 sample. Exhibit B-1 describes key characteristics of the agencies interviewed in 2017 and those interviewed this year.

Exhibit B-1. Select Characteristics of HHAs Interviewed in 2017 and 2020

		2017 Sample	2020 Sample
	Total Interviewed	**67***	**63**
State	Arizona	8	7
	Florida	14	16
	Iowa	7	6
	Maryland	6	6
	Massachusetts	5	4
	Nebraska	6	5
	North Carolina	8	8
	Tennessee	5	6
	Washington	6	5
Ownership type	For-Profit	41	37
	Not-for-Profit or Government	24	26
Chain status	Chain	33	33
	Not Chain	32	30
Facility type	Freestanding	60	58
	Hospital-Based	5	5
Size	< 100 Episodes	16	14
	100-499 Episodes	23	22
	500+ Episodes	26	27

*To compare the two samples, we used a common year of data (i.e., 2018) from home health claims and the POS file. We identified HHAs from 2018 when no HHAs that we interviewed in 2017 from the same state were available for an interview in 2020. * The totals for each characteristic add up to 65 because two of the agencies interviewed in 2017 were no longer in operation in 2018.*

We assigned an interview team to each HHA consisting of a lead interviewer and a note-taker, both of whom were trained on the discussion guide and outreach materials. The lead interviewer contacted agencies via telephone and email to invite them to voluntarily participate in the interviews. The interview team explained the topics that would be covered during the outreach and scheduling process.

In cases where previous interview participants were no longer available, we requested that the agency identify the most appropriate interview participant(s). While the titles of interviewees varied across agencies, we generally spoke with one or more of the following agency representatives: the administrator for the agency or multiple agencies within a chain (e.g., administrator, branch manager, regional director); the senior staff member responsible for clinical services; and/or the senior staff member responsible for quality improvement efforts.

B.1.2 Data Collection and Analysis

Of note, the research team conducted this year's interviews during the COVID-19 Public Health Emergency. To minimize burden on agencies during this difficult time, CMS requested that the team limit the numbers and length of the interviews. Interviews typically lasted between 20 and 45 minutes. Interviews with agencies that were part of regional and national chains typically included corporate staff and lasted longer.

The qualitative research team developed a semi-structured discussion guide to gain a longitudinal perspective of agencies' responses to HHVBP. CMS reviewed the discussion guide before the team finalized it. The team used the guide during interviews with agencies to discuss: (1) agency perceptions

of HHVBP's impact on patients and agencies; 2) agency operations and care delivery; and (3) the intersection of HHVBP with other efforts and external factors.

We audio-recorded the majority of interviews with permission of the interviewees, and research staff produced transcript-style notes for each interview in a note-taking template that mirrored the discussion guide. The template reinforced consistency in data collection across the HHAs and organized information under pre-defined headings to facilitate analysis.

Research staff summarized agency-level findings using a standardized debrief form loaded into a secure, web-based application (Survey Monkey) that enabled select members of the research team to enter, share, store, and synthesize the data. The form contained interview questions from the interview guide, response choices to aggregate participant responses, and open-ended fields for additional relevant data and quotes. We designed the debrief form to collect key information generated from the interviews, including:

- characteristics of the HHAs (state where HHA is located, patient population characteristics, chain affiliation);
- agencies' self-reported HHVBP impacts on elements of operations for the following categories: staff and training; use of technology or data analytics; clinical strategies and quality assurance and performance improvement (QAPI) planning; patient engagement and selection strategies; relationship with referral sources; use of TPS Performance Reports and other CMS resources; and
- overall influence of HHVBP on HHA operation changes, and agencies' general impressions (positive, negative, neutral) of HHVBP.

Before finalizing the form, the team tested it multiple times across several interview transcripts, identifying and refining questions or response instructions to best serve the analysis.

Three senior researchers, after completing the data entries, reviewed the data, identified trends, and summarized findings according to key topic areas. This analysis formed the basis of the findings presented in the Annual Report. The team selected quotations taken from the transcript-style notes to demonstrate common themes or interesting insights and reviewed them for quality and illustrative value.

Appendix C: Supplemental Tables and Results

C.1 Characteristics of HHAs and Patients

Exhibit C-1. HHA Characteristics in 2013 – 2019, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Total number of HHAs	2,413	2,301	2,192	2,119	2,035	1,983	1,931	9,869	9,871	9,706	9,556	9,178	8,944	8,747
Received a TPS score				77.7%	80.1%	81.8%	80.0%							
Ownership														
For-profit	79.4%	79.0%	78.5%	78.2%	78.4%	79.2%	79.4%	79.5%	79.9%	80.1%	80.6%	81.2%	82.0%	82.7%
Non-profit	14.5%	14.5%	14.9%	15.3%	15.5%	15.4%	15.1%	15.5%	15.3%	15.4%	15.3%	15.3%	14.6%	14.2%
Government-owned	6.1%	6.5%	6.6%	6.5%	6.1%	5.4%	5.5%	5.0%	4.8%	4.5%	4.2%	3.5%	3.4%	3.1%
Setting														
Hospital-based	8.1%	8.4%	8.6%	8.2%	8.0%	7.8%	7.0%	9.8%	9.2%	8.6%	8.1%	7.7%	7.3%	7.0%
Freestanding	91.9%	91.6%	91.4%	91.8%	92.0%	92.2%	93.0%	90.2%	90.8%	91.4%	91.9%	92.3%	92.7%	93.0%
Chain Affiliation														
Chain affiliated	24.4%	25.9%	27.1%	28.2%	29.7%	31.0%	33.1%	15.9%	16.0%	16.8%	17.6%	17.9%	19.2%	19.8%
No chain affiliation	61.3%	61.6%	62.7%	62.4%	62.9%	64.3%	62.3%	72.6%	72.8%	72.8%	73.0%	75.1%	76.6%	76.0%
Chain affiliation unknown	2.6%	2.6%	2.6%	3.0%	2.9%	2.9%	3.1%	2.6%	2.6%	2.6%	2.7%	2.8%	2.5%	2.4%
Chain affiliation missing	11.7%	9.9%	7.5%	6.4%	4.5%	1.8%	1.6%	8.9%	8.7%	7.8%	6.7%	4.2%	1.8%	1.8%
HHA Age														
HHA age < 4 years	27.2%	20.2%	17.6%	15.5%	12.5%	10.0%	6.9%	23.6%	19.5%	15.9%	12.9%	10.3%	9.1%	9.2%

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
HHA age 4-10 years	32.9%	36.5%	35.7%	33.1%	32.2%	31.0%	31.1%	33.4%	35.6%	36.4%	36.3%	34.6%	32.1%	29.4%
HHA age > 10 years	39.9%	43.3%	46.8%	51.3%	55.3%	59.0%	62.1%	42.9%	44.9%	47.7%	50.8%	55.1%	58.8%	61.5%
HHA Size														
1-59 OASIS Episodes	19.5%	18.8%	19.6%	19.8%	20.7%	20.1%	20.1%	25.9%	27.1%	27.0%	27.4%	26.5%	26.0%	27.0%
60-249 OASIS Episodes	29.5%	28.8%	27.1%	26.7%	23.9%	23.2%	22.7%	34.4%	33.8%	33.0%	31.3%	30.9%	30.2%	28.5%
250-499 OASIS Episodes	18.4%	19.0%	17.4%	16.4%	16.2%	16.6%	16.5%	16.5%	16.3%	16.1%	16.2%	15.6%	15.6%	15.6%
500-999 OASIS Episodes	14.7%	15.1%	16.1%	15.2%	15.7%	14.7%	14.9%	11.4%	10.9%	11.1%	11.5%	12.3%	12.6%	12.9%
≥1,000 OASIS Episodes	17.9%	18.2%	19.8%	21.9%	23.6%	25.3%	25.9%	11.8%	11.9%	12.7%	13.6%	14.7%	15.5%	15.9%

These numbers reflect all HHAs with at least one OASIS episode or Medicare claims episode in a given year, regardless if the HHA received a TPS in 2019.

Exhibit C-2. OASIS Home Health Beneficiary Characteristics in 2013 – 2019, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Total number of home health patients with an OASIS episode	994,213	995,271	1,018,426	1,037,778	1,051,446	1,067,014	1,003,832	3,248,815	3,303,445	3,421,396	3,511,557	3,589,074	3,593,989	3,457,398
Total number of OASIS episodes	1,494,075	1,492,335	1,526,387	1,566,469	1,605,197	1,674,327	1,698,642	4,777,325	4,865,038	5,055,963	5,252,578	5,467,136	5,608,596	5,697,716
Average age	75.4	75.4	75.5	75.6	75.8	75.9	76.1	74.5	74.3	74.4	74.5	74.6	74.8	74.9
Female	61.7%	61.4%	61.1%	60.9%	60.6%	60.3%	60.2%	61.9%	61.6%	61.3%	61.1%	60.8%	60.6%	60.4%
Race/Ethnicity														
Hispanic (regardless of race)	9.9%	9.0%	7.8%	7.5%	7.0%	7.4%	7.2%	7.2%	7.2%	7.1%	7.1%	7.1%	7.1%	7.1%
Black, non-Hispanic	10.5%	10.6%	10.8%	11.1%	11.3%	11.3%	11.3%	15.1%	15.0%	14.7%	14.5%	14.2%	14.2%	14.1%
White, non-Hispanic	78.1%	78.9%	79.8%	79.7%	80.0%	79.5%	79.6%	74.6%	74.7%	74.9%	75.1%	75.4%	75.2%	75.3%
Other, non-Hispanic	1.3%	1.4%	1.5%	1.6%	1.6%	1.7%	1.7%	2.9%	3.0%	3.0%	3.1%	3.2%	3.3%	3.4%
Multiracial, non-Hispanic	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Rural	4.2%	4.1%	4.1%	4.1%	4.1%	4.0%	4.0%	7.3%	7.2%	7.1%	7.1%	7.0%	7.0%	6.9%
Insurance														
% Dual eligible	28.9%	27.6%	26.3%	25.5%	24.5%	23.7%	22.9%	27.8%	27.4%	26.9%	26.5%	26.1%	25.7%	24.7%
% Medicaid only (either managed care or FFS without dual)	3.7%	4.2%	4.4%	4.5%	4.3%	4.1%	4.0%	5.5%	6.0%	6.3%	6.2%	6.1%	6.0%	5.9%
Persons aged ≥25 years with less than high-school (HS)	12.5%	12.5%	12.4%	12.2%	12.1%	12.2%	12.1%	13.7%	13.7%	13.6%	13.6%	13.5%	13.5%	13.5%

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
diploma in the beneficiary's county														
Change in % of home health beneficiaries from previous year	N/A	0.1%	2.3%	1.9%	1.3%	1.5%	-5.9%	N/A	1.7%	3.6%	2.6%	2.2%	0.1%	-3.8%

These numbers reflect all OASIS episodes in the CY, regardless if their HHA received a TPS in 2019.

Exhibit C-3. OASIS Clinical Factors in 2013 – 2019, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Total number of OASIS episodes	1,494,075	1,492,335	1,526,387	1,566,469	1,605,197	1,674,327	1,698,642	4,777,325	4,865,038	5,055,963	5,252,578	5,467,136	5,608,596	5,697,716
Discharged from inpatient facility in last 14 days	67.1%	67.4%	68.8%	68.8%	69.4%	69.2%	68.8%	71.5%	71.3%	71.5%	71.3%	71.5%	71.1%	71.0%
Neoplasm diagnosis	8.0%	8.1%	8.2%	8.5%	8.6%	8.7%	9.0%	8.7%	8.7%	8.6%	8.9%	8.9%	9.0%	9.2%
Requires urinary catheter	4.3%	4.4%	4.4%	4.5%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.7%	4.6%	4.6%
Surgical wound	24.0%	24.4%	24.7%	25.4%	25.5%	25.5%	25.4%	25.2%	25.9%	25.8%	26.3%	26.6%	26.7%	26.9%
Ambulation-Locomotion														
Able to independently walk and needs no human assistance or assistive device	5.6%	4.5%	4.1%	3.2%	2.4%	2.1%	2.0%	5.8%	5.0%	4.2%	3.3%	2.6%	2.1%	2.0%
Able to independently walk with the use of a one-handed device	10.7%	9.0%	7.7%	5.8%	4.3%	3.6%	3.1%	11.6%	10.1%	8.8%	7.0%	5.5%	4.6%	3.8%
Requires two handed device or human assistance	35.9%	32.5%	28.7%	22.5%	17.7%	14.9%	13.0%	35.2%	33.0%	30.3%	26.1%	22.4%	19.1%	16.7%
Walks only with supervision or assistance from another at all times	37.0%	42.8%	47.9%	55.8%	61.9%	65.3%	67.6%	35.8%	40.1%	44.6%	50.9%	56.3%	60.5%	63.7%
Chairfast to bedfast	10.8%	11.2%	11.6%	12.6%	13.6%	14.0%	14.2%	11.7%	11.9%	12.1%	12.7%	13.3%	13.7%	13.9%

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Pressure Ulcer														
Pressure Ulcer Stage 2	3.2%	3.2%	3.2%	3.0%	2.9%	3.0%	3.0%	3.5%	3.4%	3.3%	3.2%	3.0%	3.1%	3.1%
Pressure Ulcer Stage 3	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%
Pressure Ulcer Stage 4	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Pressure Ulcer Not Stageable	0.9%	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.0%	1.1%	1.1%
Risk for Hospitalization*														
Multiple hospitalizations in past 6 months	37.4%	38.4%	33.6%	32.0%	32.2%	32.3%	32.8%	38.7%	38.9%	34.0%	32.2%	32.5%	32.5%	33.0%
History of falls	31.6%	33.5%	33.4%	33.6%	34.7%	35.1%	35.9%	30.8%	31.9%	31.6%	31.6%	32.3%	32.9%	33.6%
Currently taking 5 or more medications	87.6%	87.8%	89.5%	91.1%	92.1%	92.3%	92.7%	86.2%	86.6%	88.2%	90.0%	91.6%	92.0%	92.7%

*These numbers reflect all OASIS episodes in the CY, regardless if their HHA received a TPS in 2019. *Categories for this condition are not mutually exclusive*

Exhibit C-4. FFS Home Health Beneficiary Characteristics in 2013 – 2019, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Total number of beneficiaries with Medicare FFS home health claims	850,868	834,565	840,408	833,486	820,040	821,059	801,137	2,631,986	2,618,829	2,647,827	2,659,592	2,606,539	2,569,811	2,473,954
Total number of FFS episodes	1,501,589	1,460,096	1,461,245	1,430,348	1,402,802	1,411,557	1,373,277	5,173,186	5,113,875	5,130,487	5,080,946	4,916,118	4,816,522	4,577,043
Average age (years)	76.8	77.0	77.2	77.3	77.5	77.6	77.8	75.8	75.8	76.0	76.1	76.2	76.3	76.5
Female	62.5%	62.1%	61.7%	61.4%	61.0%	60.6%	60.3%	63.2%	62.7%	62.4%	62.1%	61.7%	61.3%	60.9%
Race/Ethnicity														
Hispanic (regardless of race)	10.9%	9.6%	7.9%	6.8%	6.0%	6.0%	6.0%	8.8%	8.5%	8.2%	7.9%	7.8%	7.5%	7.3%
Black, non-Hispanic	10.1%	10.0%	10.2%	10.2%	10.2%	10.0%	9.7%	17.1%	16.6%	15.8%	14.8%	14.1%	13.6%	13.0%
White, non-Hispanic	77.7%	79.1%	80.5%	81.6%	82.3%	82.4%	82.7%	71.0%	71.7%	72.7%	73.9%	74.6%	75.2%	75.8%
Other, non-Hispanic	1.2%	1.2%	1.3%	1.4%	1.4%	1.4%	1.5%	2.9%	3.0%	3.1%	3.2%	3.3%	3.5%	3.7%
Multiracial, non-Hispanic	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Rural	5.0%	4.9%	4.9%	5.0%	5.0%	4.9%	4.9%	9.5%	9.4%	9.3%	9.3%	9.2%	9.1%	9.0%
Dual eligible	32.0%	30.4%	28.4%	27.0%	25.8%	24.7%	23.9%	35.1%	34.7%	33.7%	32.9%	32.7%	32.3%	31.5%
Persons aged ≥25 years with less than HS diploma in the beneficiary's county	12.8%	12.6%	12.4%	12.3%	12.2%	12.2%	12.2%	15.0%	14.9%	14.8%	14.7%	14.6%	14.5%	14.5%
Reason for Medicare Entitlement														
Original End-Stage Renal Disease	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.6%	1.6%	1.6%	1.6%	1.5%	1.6%	1.6%
Original Disabled	25.4%	25.4%	25.2%	25.1%	24.8%	24.4%	23.9%	28.7%	29.0%	28.7%	28.5%	28.1%	27.8%	27.1%
Current End-Stage Renal Disease	0.8%	0.8%	0.7%	0.5%	0.4%	0.4%	0.4%	1.1%	1.1%	0.9%	0.6%	0.6%	0.6%	0.5%
Current Disabled	12.4%	12.1%	11.6%	11.3%	10.8%	10.2%	9.6%	14.6%	14.5%	14.1%	13.6%	13.1%	12.6%	11.9%
Alternative Payment Models (APMs)														
BPCI2	0.0%	0.3%	2.5%	3.9%	2.9%	1.9%	N/A	0.0%	0.5%	2.1%	3.0%	2.4%	1.8%	N/A

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
BPCI3	0.0%	0.1%	0.3%	0.5%	0.5%	0.3%	N/A	0.0%	0.2%	0.3%	0.5%	0.4%	0.3%	N/A
BPCI Advanced*	N/A	N/A	N/A	N/A	N/A	0.7%	3.4%	N/A	N/A	N/A	N/A	N/A	0.7%	4.0%
ACO SSP	13.0%	18.7%	23.1%	21.7%	27.9%	32.8%	32.9%	9.3%	14.6%	20.2%	23.0%	26.4%	29.8%	31.5%
ACO Next Generation*	N/A	N/A	N/A	3.3%	6.5%	8.9%	7.4%	N/A	N/A	N/A	1.4%	3.6%	4.1%	3.5%
ACO Pioneer*	4.1%	4.3%	5.1%	3.7%	N/A	N/A	N/A	2.6%	1.7%	1.6%	0.5%	N/A	N/A	N/A
CJR*	N/A	N/A	N/A	0.6%	1.0%	0.7%	0.7%	N/A	N/A	N/A	0.8%	1.1%	0.8%	0.7%
OCM*	N/A	N/A	N/A	1.3%	3.1%	3.1%	1.3%	N/A	N/A	N/A	1.3%	3.0%	3.1%	1.3%
HCC score (1st episode)	2.6	2.7	2.7	2.8	2.9	3.0	3.0	2.6	2.6	2.6	2.7	2.8	2.9	3.0
Full FFS status for the past 12 months	92.4%	92.4%	92.2%	92.1%	92.3%	92.3%	92.4%	91.0%	90.6%	89.3%	89.4%	90.1%	89.8%	90.2%
ESRD Flag#	2.8%	2.9%	3.0%	3.1%	3.2%	3.2%	3.3%	3.6%	3.7%	3.7%	3.8%	3.8%	3.9%	4.0%
Oxygen	14.6%	14.4%	14.5%	14.5%	14.2%	13.4%	12.9%	16.6%	16.2%	16.2%	15.9%	15.6%	15.0%	14.5%
PDGM Home health admission source														
Acute Inpatient Hospital	27.2%	27.9%	28.7%	29.3%	30.0%	29.5%	29.2%	25.7%	26.1%	26.7%	27.2%	28.0%	27.8%	28.0%
Inpatient Psychiatric Facility	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Inpatient Rehabilitation Facility	2.9%	3.0%	3.2%	3.3%	3.5%	3.7%	3.8%	3.6%	3.8%	4.0%	4.1%	4.2%	4.4%	4.6%
Long-Term Care Hospital	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.6%	0.7%	0.7%	0.6%	0.6%	0.5%	0.4%
Skilled Nursing Home	17.1%	18.0%	19.0%	19.1%	19.1%	18.8%	18.6%	14.5%	15.5%	16.3%	16.6%	16.8%	16.8%	16.6%
Community	51.9%	50.2%	48.2%	47.6%	46.6%	47.3%	47.7%	55.1%	53.5%	51.9%	51.1%	50.1%	50.2%	50.1%
Admission Source (Arbor defined)														
Institution	76.9%	76.7%	76.2%	75.6%	74.1%	74.3%	74.4%	78.9%	79.2%	78.9%	78.1%	76.7%	76.6%	76.2%
Community	23.1%	23.3%	23.8%	24.4%	25.9%	25.7%	25.6%	21.1%	20.8%	21.1%	21.9%	23.3%	23.4%	23.8%
PDGM defined Clinical grouping														
Behavioral Health	2.4%	2.5%	2.5%	2.3%	2.2%	2.3%	2.5%	1.4%	1.6%	1.6%	1.6%	1.6%	1.5%	1.6%

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Complex Nursing Interventions	1.1%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
MMTA Surgical Aftercare	7.1%	7.3%	7.1%	6.3%	6.0%	5.9%	5.8%	5.9%	6.1%	6.0%	5.2%	5.0%	4.8%	4.8%
MMTA Cardiac and Circulatory	11.5%	11.7%	12.3%	12.4%	12.1%	12.4%	13.4%	15.0%	15.9%	16.4%	16.3%	16.0%	16.0%	16.7%
MMTA Endocrine	4.9%	5.2%	4.9%	4.3%	4.2%	3.9%	4.2%	7.3%	7.7%	7.3%	6.3%	6.0%	5.7%	5.7%
MMTA Gastrointestinal tract/Genitourinary system	3.0%	3.3%	3.6%	3.9%	4.1%	4.3%	4.7%	2.9%	3.2%	3.4%	3.8%	4.0%	4.2%	4.5%
MMTA Infectious Disease	2.1%	2.2%	2.3%	3.0%	3.3%	3.6%	4.1%	2.3%	2.3%	2.5%	3.2%	3.4%	3.7%	4.1%
MMTA Other	1.3%	1.3%	1.4%	1.6%	1.8%	1.9%	2.4%	1.4%	1.4%	1.5%	1.7%	1.9%	2.0%	2.3%
MMTA Respiratory	6.3%	6.3%	6.9%	7.0%	7.5%	7.4%	7.3%	6.6%	6.7%	7.2%	7.3%	7.7%	7.7%	7.6%
MS Rehab	11.5%	11.7%	13.0%	18.4%	19.4%	20.6%	22.1%	9.8%	10.5%	12.2%	17.2%	18.6%	19.9%	21.5%
Neuro Rehab	5.7%	6.1%	6.8%	8.4%	9.0%	9.4%	10.1%	5.9%	6.4%	7.0%	8.2%	8.6%	8.8%	9.4%
Wounds	2.6%	2.7%	4.2%	9.2%	10.0%	10.4%	10.9%	2.4%	2.6%	3.7%	7.7%	8.7%	9.2%	9.7%
None	40.6%	38.4%	33.8%	22.0%	19.1%	16.7%	11.2%	38.1%	34.5%	30.1%	20.2%	17.4%	15.4%	10.8%
% Change in home health beneficiaries from previous year	N/A	-1.9%	0.7%	-0.8%	-1.6%	0.1%	-2.4%	N/A	-0.5%	1.1%	0.4%	-2.0%	-1.4%	-3.7%

These numbers reflect the percentages of all Medicare FFS home health episodes in the CY, regardless if their HHA received a TPS score in 2019.

** Values listed as "N/A" reflect years where the APM is not active.*

[#]This is defined as either having an unfailed kidney transplant at the start of home health episode or having a dialysis claim during the 365 days before the home health episode begins.

Exhibit C-5. FFS Episode Characteristics in 2013 – 2019, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Total number of FFS episodes	1,501,589	1,460,096	1,461,245	1,430,348	1,402,802	1,411,557	1,373,277	5,173,186	5,113,875	5,130,487	5,080,946	4,916,118	4,816,522	4,577,043
Episodes Type*														
Normal	83.9%	84.5%	84.4%	83.9%	83.9%	84.2%	84.0%	86.3%	86.9%	86.6%	86.0%	85.3%	85.5%	85.5%
LUPA	9.2%	9.1%	9.1%	9.1%	8.9%	8.6%	8.7%	8.8%	8.7%	8.7%	8.6%	8.6%	8.5%	8.5%
High cost outlier	4.4%	3.9%	4.1%	4.5%	4.5%	4.5%	4.5%	2.9%	2.5%	2.7%	3.3%	4.0%	3.9%	3.9%
PEP	3.7%	3.6%	3.6%	3.7%	3.9%	3.9%	4.0%	3.0%	2.8%	2.9%	3.0%	3.2%	3.1%	3.2%
Episodes within a Sequence														
1st in sequence	59.3%	59.4%	58.9%	59.5%	59.8%	59.3%	59.4%	48.6%	49.2%	49.9%	50.9%	52.0%	52.5%	53.1%
2nd in sequence	15.3%	15.6%	15.7%	16.0%	16.4%	16.5%	16.3%	15.0%	15.2%	15.4%	15.6%	16.0%	16.3%	16.2%
3rd+ in sequence	25.5%	25.0%	25.3%	24.5%	23.8%	24.2%	24.3%	36.3%	35.6%	34.7%	33.5%	32.0%	31.2%	30.6%
Average number of visits in an episode	18.1	18.0	17.9	17.8	17.5	17.7	17.3	16.4	16.3	16.2	16.3	16.3	16.4	16.2
Average # of Visits by Type														
Therapy (OT, PT, speech)	7.5	7.7	7.9	8.1	8.4	8.6	8.6	5.5	5.7	6.1	6.5	6.8	7.2	7.2
Skilled nurse	8.8	8.6	8.4	8.1	7.9	7.8	7.6	8.5	8.3	8.2	8.1	7.9	7.8	7.7
Home health aide	1.7	1.6	1.5	1.3	1.2	1.1	1.0	2.3	2.1	1.9	1.7	1.5	1.4	1.2
Medical social services	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

These numbers reflect all FFS home health episodes in the CY, regardless if their HHA received a TPS score in 2019.

**PEP (Partial Episode Payment) is not mutually exclusive with LUPA (Low-Utilization Payment Adjustment) and Outlier, so percentages may sum to > 100%. A PEP occurs when a beneficiary changes HHAs or is discharged and readmitted within a 60-day episode and results in an adjusted, partial payment to the HHA to reflect the time the beneficiary received care.*

C.2 Annual Means for TPS, Spending Measures, and Quality Measures

Exhibit C-6. Unadjusted Annual Means (and Standard Errors††) for Impact Measures 2013 – 2019, HHVBP States

Measure	2013	2014	2015	2016	2017	2018	2019
TPS†	30.9 (0.3561)	28.1 (0.3452)	30.9 (0.3621)	37.1 (0.4141)	42.6 (0.4102)	45.4 (0.4289)	38.9 (0.4151)
FFS Claims-Based Quality Measures							
Unplanned Acute Care Hospitalization/First FFS HH Episodes	15.3% (0.0417)	15.6% (0.0427)	16.1% (0.0433)	16.3% (0.0439)	15.9% (0.0436)	15.6% (0.0434)	15.3% (0.0441)
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes	11.3% (0.0367)	11.7% (0.0378)	12.2% (0.0386)	12.6% (0.0395)	12.9% (0.0400)	12.9% (0.0400)	13.0% (0.0441)
ED Use followed by Inpatient Admission/First FFS HH Episodes	13.8% (0.0399)	14.3% (0.0410)	14.5% (0.0414)	14.4% (0.0416)	14.8% (0.0423)	14.7% (0.0422)	14.5% (0.0426)
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes	25.8% (0.0506)	26.7% (0.0518)	27.4% (0.0524)	27.8% (0.0530)	28.3% (0.0537)	28.1% (0.0536)	28.1% (0.0543)
Outpatient ED Use and Observation Stay (no Hospitalization)/ First FFS HH Episode	13.8% (0.0399)	14.1% (0.0407)	14.5% (0.0414)	15.1% (0.0424)	15.4% (0.0430)	15.4% (0.0430)	15.5% (0.0436)
Unplanned Acute Care Hospitalization/All FFS HH Episodes	16.8% (0.0332)	17.2% (0.0339)	17.0% (0.0338)	16.8% (0.0340)	17.2% (0.0346)	16.9% (0.0343)	16.9% (0.0347)
SNF Use/All FFS HH Episodes	4.7% (0.0189)	5.0% (0.0195)	5.0% (0.0196)	5.0% (0.0197)	5.1% (0.0201)	4.9% (0.0198)	4.9% (0.0200)
FFS Claims-Based Spending Measures							
Average Medicare Spending per Day during and following FFS HH Episodes of Care	$135.41 (0.1471)	$138.65 (0.1522)	$140.99 (0.1546)	$143.18 (0.1594)	$146.65 (0.1644)	$150.65 (0.1688)	$ 154.57 (0.1757)
Average Medicare Spending per Day during FFS HH Episodes of Care	$148.31 (0.1546)	$150.69 (0.1596)	$152.83 (0.1621)	$155.47 (0.1675)	$159.21 (0.1735)	$163.12 (0.1784)	$168.27 (0.1862)
Average Medicare Spending per Day following FFS HH Episodes of Care	$102.03 (0.2393)	$106.79 (0.2496)	$109.25 (0.2542)	$110.68 (0.2578)	$113.46 (0.2654)	$116.31 (0.2710)	$118.86 (0.2773)
OASIS-Based Outcome Quality Measures							
Discharged to Community	73.0% (0.0366)	72.8% (0.0367)	72.4% (0.0365)	72.9% (0.0358)	72.8% (0.0354)	73.2% (0.0345)	73.5% (0.0341)
Total Normalized Composite (TNC) Change in Self-Care	1.29 (0.0010)	1.37 (0.0011)	1.46 (0.0011)	1.65 (0.0011)	1.79 (0.0011)	1.88 (0.0011)	1.98 (0.0010)
Total Normalized Composite (TNC) Change in Mobility	0.39 (0.0004)	0.43 (0.0004)	0.48 (0.0004)	0.57 (0.0004)	0.64 (0.0004)	0.69 (0.0004)	0.72 (0.0004)
Improvement in Dyspnea	64.5% (0.0546)	65.2% (0.0541)	70.1% (0.0511)	74.9% (0.0464)	79.5% (0.0419)	81.9% (0.0383)	84.8% (0.0352)
Improvement in Management of Oral Medications	48.8% (0.0569)	50.5% (0.0559)	55.0% (0.0538)	61.6% (0.0498)	67.5% (0.0460)	71.3% (0.0427)	76.5% (0.0394)

Measure	2013	2014	2015	2016	2017	2018	2019
Improvement in Pain Interfering with Activity	70.4% (0.0491)	69.9% (0.0490)	71.9% (0.0474)	76.7% (0.0431)	80.3% (0.0398)	82.6% (0.0368)	85.4% (0.0392)
Improvement in Status of Surgical Wounds	90.2% (0.0744)	90.2% (0.0760)	90.5% (0.0762)	91.4% (0.0732)	92.2% (0.0710)	92.6% (0.0695)	93.2% (0.0788)
FFS Claims-Based Quality Measure							
Mortality Rate/All FFS Home Health Episodes	3.4% (0.0150)	3.5% (0.0154)	3.5% (0.0155)	3.6% (0.0157)	3.7% (0.0161)	3.6% (0.0159)	3.5% (0.0160)
HHCAHPS-Based Patient Experience Measures							
How often the home health team gave care in a professional way (Professional Care)	89.0% (0.1245)	88.7% (0.1412)	88.7% (0.1416)	88.5% (0.1298)	88.4% (0.1377)	88.4% (0.1383)	88.2% (0.1439)
How well did the home health team communicate with patients (Communication)	86.2% (0.1467)	85.9% (0.1664)	85.7% (0.1583)	85.5% (0.1530)	85.5% (0.1541)	85.4% (0.1639)	85.3% (0.1721)
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)	82.9% (0.1828)	82.8% (0.1835)	82.8% (0.1839)	82.3% (0.1902)	82.6% (0.1849)	82.2% (0.1998)	81.9% (0.2116)
How do patients rate the overall care from the home health agency (Overall Care)	84.6% (0.1993)	84.3% (0.2245)	84.3% (0.2187)	84.3% (0.2086)	84.1% (0.2062)	84.3% (0.2014)	84.2% (0.2204)
Would patients recommend the home health agency to friends and family (Likely to Recommend)	79.8% (0.2382)	79.8% (0.2735)	79.4% (0.2639)	79.2% (0.2578)	78.9% (0.2497)	78.8% (0.2687)	78.5% (0.2658)

HHVBP Measures indicated by italic text.† We calculated a TPS score for each agency that was eligible to receive one, based on having at least five HHVBP measures with sufficient data and a Medicare participation date prior to the CY used as a baseline period for measuring improvement. †† Standard Errors are reported in the same units as the corresponding measure means.

Exhibit C-7. Unadjusted Annual Means (and Standard Errors††) for Impact Measures 2013 – 2019, Non-HHVBP States

Measure	2013	2014	2015	2016	2017	2018	2019
TPS†	30.4 (0.1762)	28.4 (0.1763)	30.6 (0.1834)	34.9 (0.1996)	40.0 (0.2007)	42.9 (0.2108)	36.6 (0.2048)
FFS Claims-Based Quality Measures							
Unplanned Acute Care Hospitalization/First FFS HH Episodes	16.2% (0.0258)	16.2% (0.0258)	16.3% (0.0258)	16.5% (0.0257)	15.8% (0.0253)	15.6% (0.0254)	15.4% (0.0260)
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes	11.9% (0.0226)	12.4% (0.0230)	12.6% (0.0231)	12.7% (0.0231)	13.0% (0.0234)	12.9% (0.0234)	13.0% (0.0241)
ED Use followed by Inpatient Admission/First FFS HH Episodes	14.2% (0.0243)	14.3% (0.0244)	14.2% (0.0242)	14.2% (0.0240)	14.3% (0.0242)	14.2% (0.0243)	14.2% (0.0247)
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes	27.2% (0.0310)	27.7% (0.0312)	27.9% (0.0311)	28.1% (0.0310)	28.3% (0.0312)	28.0% (0.0313)	28.1% (0.0318)
Outpatient ED Use and Observation Stay (no Hospitalization)/ First FFS HH Episode	13.7% (0.0239)	14.1% (0.0243)	14.5% (0.0245)	14.8% (0.0245)	15.0% (0.0247)	15.0% (0.0249)	15.2% (0.0254)
Unplanned Acute Care Hospitalization/All FFS HH Episodes	15.9% (0.0176)	15.9% (0.0177)	15.7% (0.0177)	15.6% (0.0177)	15.9% (0.0181)	15.8% (0.0183)	15.9% (0.0187)
SNF Use/All FFS HH Episodes	3.9% (0.0093)	4.0% (0.0095)	4.1% (0.0097)	4.2% (0.0097)	4.2% (0.0100)	4.2% (0.0101)	4.2% (0.0103)
FFS Claims-Based Spending Measures							
Average Medicare Spending per Day during and following FFS HH Episodes of Care	$128.79 (0.0816)	$131.80 (0.0834)	$134.25 (0.0844)	$137.36 (0.0867)	$141.84 (0.0904)	$146.56 (0.0939)	$152.02 (0.0994)
Average Medicare Spending per Day during FFS HH Episodes of Care	$132.49 (0.0832)	$135.31 (0.0850)	$138.26 (0.0861)	$142.17 (0.0889)	$147.43 (0.0931)	$152.99 (0.0970)	$159.42 (0.1029)
Average Medicare Spending per Day following FFS HH Episodes of Care	$113.66 (0.1569)	$117.45 (0.1610)	$118.51 (0.1612)	$119.47 (0.1607)	$122.06 (0.1650)	$124.34 (0.1690)	$127.70 (0.1747)
OASIS-Based Outcome Quality Measures							
Discharged to Community	69.8% (0.0212)	70.1% (0.0209)	70.5% (0.0205)	71.0% (0.0200)	71.3% (0.0195)	71.8% (0.0192)	72.3% (0.0189)
Total Normalized Composite (TNC) Change in Self-Care	1.20 (0.0006)	1.27 (0.0006)	1.37 (0.0006)	1.52 (0.0006)	1.65 (0.0006)	1.75 (0.0006)	1.86 (0.0006)
Total Normalized Composite (TNC) Change in Mobility	0.37 (0.0002)	0.40 (0.0002)	0.45 (0.0002)	0.52 (0.0002)	0.59 (0.0002)	0.63 (0.0002)	0.67 (0.0002)
Improvement in Dyspnea	64.4% (0.0315)	65.1% (0.0309)	68.7% (0.0291)	72.2% (0.0270)	76.2% (0.0248)	79.0% (0.0228)	82.2% (0.0210)
Improvement in Management of Oral Medications	51.6% (0.0323)	53.2% (0.0314)	56.5% (0.0300)	60.8% (0.0281)	65.3% (0.0260)	69.0% (0.0244)	74.7% (0.0224)
Improvement in Pain Interfering with Activity	66.6% (0.0289)	67.0% (0.0282)	69.5% (0.0269)	73.6% (0.0248)	77.1% (0.0230)	79.9% (0.0214)	82.7% (0.0230)

Measure	2013	2014	2015	2016	2017	2018	2019
Improvement in Status of Surgical Wounds	89.0% (0.0425)	89.0% (0.0427)	89.5% (0.0422)	90.3% (0.0408)	90.7% (0.0404)	91.2% (0.0401)	91.9% (0.0452)
FFS Claims-Based Quality Measure							
Mortality Rate/All FFS Home Health Episodes	3.2% (0.0080)	3.3% (0.0081)	3.3% (0.0080)	3.3% (0.0081)	3.3% (0.0083)	3.3% (0.0083)	3.3% (0.0086)
HHCAHPS-Based Patient Experience Measures							
How often the home health team gave care in a professional way (Professional Care)	88.2% (0.0709)	88.2% (0.0702)	88.2% (0.0749	88.0% (0.0763)	87.9% (0.0798)	88.0% (0.0755)	88.0% (0.0826)
How well did the home health team communicate with patients (Communication)	85.4% (0.0761)	85.3% (0.0788)	85.2% (0.0832)	85.2% (0.0857)	85.1% (0.0876)	85.2% (0.0860)	85.2% (0.0894)
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)	83.8% (0.0881)	83.9% (0.0875)	83.6% (0.0914)	83.6% (0.0932)	83.3% (0.0975)	83.4% (0.0965)	83.5% (0.0977)
How do patients rate the overall care from the home health agency (Overall Care)	83.6% (0.1110)	83.7% (0.1127)	83.7% (0.1200)	83.7% (0.1215)	83.5% (0.1248)	83.4% (0.1246)	83.7% (0.1280)
Would patients recommend the home health agency to friends and family (Likely to Recommend)	78.5% (0.1364)	78.5% (0.1378)	78.3% (0.1428)	78.1% (0.1427)	77.6% (0.1479)	77.4% (0.1483)	77.5% (0.1534)

HHVBP Measures indicated by italic text.† We calculated a TPS score for each agency that was eligible to receive one, based on having at least five HHVBP measures with sufficient data and a Medicare participation date prior to the CY used as a baseline period for measuring improvement. †† Standard Errors are reported in the same units as the corresponding measure means.

C.3 Home Health Utilization Supporting Analyses

Exhibit C-8. Number of HHAs 2013 – 2019, by HHVBP State

State	2013	2014	2015	2016	2017	2018	2019
Arizona (AZ)	154	159	158	156	161	163	161
Florida (FL)	1,399	1,279	1,163	1,073	984	945	915
Iowa (IA)	168	164	162	162	159	156	146
Maryland (MD)	55	54	54	52	53	52	52
Massachusetts (MA)	174	187	204	229	238	236	228
Nebraska (NE)	78	76	76	76	76	75	73
North Carolina (NC)	177	177	174	172	171	169	167
Tennessee (TN)	146	143	138	137	131	127	125
Washington (WA)	62	62	63	62	62	60	64
All HHVBP States	2,413	2,301	2,192	2,119	2,035	1,983	1,931
All Non-HHVBP States	9,869	9,871	9,706	9,556	9,178	8,944	8,747

Reflects HHAs that have at least one home health episode in the year.

C.3.1 Entry/Exit Supporting Analyses

Exhibit C-9. Number of HHAs Opening and Terminating Quarterly in HHVBP and Non-HHVBP States, 2013 – 2019

		Opening HHAs (n)		Terminating HHAs (n)		Open HHAs* (n)	
Year	Quarter	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP
2013	Q1	37	141	23	55	2,452	10,013
	Q2	29	147	30	78	2,458	10,105
	Q3	24	111	63	66	2,452	10,138
	Q4	22	91	54	75	2,411	10,163
2014	Q1	22	71	56	79	2,379	10,159
	Q2	20	72	57	105	2,343	10,152
	Q3	24	70	41	108	2,310	10,117
	Q4	19	60	46	81	2,288	10,069
2015	Q1	28	51	27	69	2,270	10,039
	Q2	18	54	34	91	2,261	10,024
	Q3	28	69	23	76	2,255	10,002
	Q4	22	69	20	101	2,254	9,995
2016	Q1	39	52	28	91	2,273	9,946
	Q2	20	50	25	93	2,265	9,905
	Q3	17	82	23	171	2,257	9,894
	Q4	15	44	38	121	2,249	9,767
2017	Q1	6	38	20	116	2,217	9,684
	Q2	12	56	26	93	2,209	9,624
	Q3	7	47	28	100	2,190	9,578
	Q4	10	46	23	118	2,172	9,524
2018	Q1	10	61	19	84	2,159	9,467
	Q2	6	54	18	113	2,134	9,429
	Q3	10	73	16	92	2,122	9,371

		Opening HHAs (n)		Terminating HHAs (n)		Open HHAs* (n)	
Year	Quarter	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP
	Q4	9	62	20	81	2,113	9,337
2019	Q1	5	65	21	86	2,097	9,316
	Q2	10	69	17	114	2,086	9,299
	Q3	N/A	N/A	N/A	N/A	N/A	N/A
	Q4	N/A	N/A	N/A	N/A	N/A	N/A

Gray shading indicates data not available due to data lag in the POS file.
**Open HHAs are defined by the POS certification and termination dates and may include inactive HHAs that do not have HH episodes in a given quarter.*

C.3.2 Utilization of Home Health by FFS Beneficiaries Supporting Analyses

Exhibit C-10. Unadjusted Annual Means (and Standard Errors) for Home Health Utilization Measures, HHVBP States, 2013 – 2019

Measure	2013	2014	2015	2016	2017	2018	2019
% FFS Beneficiaries with at least one HH Episode	10.44% (0.2077)	10.20% (0.1906)	10.22% (0.1729)	9.99% (0.1768)	9.77% (0.1679)	9.76% (0.1680)	9.57% (0.1653)
Number of HH Episodes per 1,000 FFS Beneficiaries	182.21 (5.1421)	176.30 (4.4099)	175.37 (3.8324)	169.62 (3.5961)	165.27 (3.2998)	165.96 (3.3274)	162.27 (3.3027)

Standard Errors are expressed in the same units as means

Exhibit C-11. Unadjusted Annual Means (and Standard Errors) for Home Health Utilization Measures, Non-HHVBP States, 2013 – 2019

Measure	2013	2014	2015	2016	2017	2018	2019
% FFS Beneficiaries with at least one HH Episode	9.89% (0.0740)	9.76% (0.0708)	9.87% (0.0705)	9.82% (0.0684)	9.66% (0.0666)	9.57% (0.0671)	9.28% (0.0666)
Number of HH Episodes per 1,000 FFS Beneficiaries	191.39 (2.4748)	187.75 (2.3387)	188.53 (2.2539)	184.95 (2.1249)	179.69 (1.9740)	176.88 (1.8988)	169.46 (1.8321)

Standard Errors are expressed in the same units as means

C.3.3 Case-mix of Home Health Beneficiaries Supporting Analyses

Exhibit C-12. Unadjusted Annual Means (and Standard Errors) for Health Status Measures at the Start of Care, HHVBP States, 2013 – 2019

Measure	2013	2014	2015	2016	2017	2018	2019
HCC Score at the Start of Care	2.6 (0.0014)	2.7 (0.0015)	2.7 (0.0015)	2.8 (0.0016)	2.9 (0.0016)	3.0 (0.0016)	3.0 (0.0017)
TNC Mobility at the Start of Care	4.7 (0.0022)	5.0 (0.0022)	5.2 (0.0021)	5.7 (0.0021)	6.1 (0.0020)	6.3 (0.0019)	6.4 (0.0019)
TNC Self-Care at the Start of Care	9.3 (0.0037)	9.7 (0.0036)	10.1 (0.0035)	10.7 (0.0034)	11.2 (0.0032)	11.5 (0.0030)	11.6 (0.0030)

Exhibit C-13. Unadjusted Annual Means (and Standard Errors) for Health Status Measures at the Start of Care, non-HHVBP States, 2013 – 2019

Measure	2013	2014	2015	2016	2017	2018	2019
HCC Score at the Start of Care	2.6 (0.0008)	2.6 (0.0008)	2.6 (0.0008)	2.7 (0.0008)	2.8 (0.0009)	2.9 (0.0009)	3.0 (0.0009)
TNC Mobility at the Start of Care	4.8 (0.0013)	5.0 (0.0013)	5.2 (0.0012)	5.6 (0.0012)	5.9 (0.0011)	6.2 (0.0011)	6.3 (0.0010)
TNC Self-Care at the Start of Care	9.3 (0.0021)	9.6 (0.0021)	9.9 (0.0020)	10.4 (0.0019)	10.9 (0.0018)	11.2 (0.0017)	11.3 (0.0016)

C.3.4 Access to Home Health Care Supporting Analyses

Exhibit C-14. Characteristics of FFS Episodes in Low Access Counties by Rural/Urban Location in HHVBP and Non-HHVBP States

	HHVBP								Non-HHVBP							
	Rural				Urban				Rural				Urban			
	Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access	
	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post
N FFS episodes	5,289	10,843	212,780	266,318	19,621	18,066	4,185,206	5,322,691	64,953	91,521	1,388,109	1,683,831	145,272	202,567	13,819,098	17,412,551
Average Age (yrs)	76.0	76.0	75.8	76.1	76.9	75.1	77.1	77.6	75.7	75.9	75.5	75.5	76.8	76.3	75.9	76.4
Female	58.9%	59.9%	62.3%	61.0%	60.3%	57.7%	62.1%	60.8%	62.1%	60.0%	62.6%	61.1%	60.4%	59.3%	62.8%	61.6%
Race/Ethnicity																
Hispanic (regardless of race)	1.8%	1.2%	0.4%	0.5%	3.8%	3.6%	10.0%	6.5%	6.3%	10.0%	2.7%	2.2%	26.1%	23.6%	8.9%	8.0%
Black, non-Hispanic	9.6%	12.9%	9.4%	9.6%	10.1%	14.7%	10.1%	10.0%	12.3%	4.9%	12.4%	11.3%	3.5%	4.1%	17.0%	14.3%
White, non-Hispanic	86.4%	83.4%	89.5%	89.2%	84.3%	70.7%	78.5%	81.9%	80.3%	83.4%	83.0%	84.5%	67.0%	68.4%	70.7%	74.0%
Other, non-Hispanic	2.2%	2.3%	0.5%	0.6%	1.6%	10.9%	1.3%	1.4%	1.0%	1.4%	1.7%	1.7%	3.2%	3.6%	3.2%	3.6%
Multiracial, non-Hispanic	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Dual Eligible	31.8%	33.4%	37.1%	33.2%	25.6%	34.8%	30.0%	25.0%	35.8%	34.0%	38.2%	35.4%	36.4%	36.8%	34.1%	32.0%
HCC Score (1st episode)	2.70	2.81	2.61	2.89	2.78	3.14	2.67	2.93	2.39	2.78	2.41	2.70	2.63	2.79	2.62	2.85
ESRD Flag	2.8%	2.6%	2.5%	2.7%	2.8%	4.7%	2.9%	3.2%	2.6%	2.6%	2.5%	2.8%	3.8%	4.0%	3.8%	4.0%

	HHVBP								Non-HHVBP							
	Rural				Urban				Rural				Urban			
	Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access	
	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post
Discharged from inpatient facility in last 14 days	72.5%	65.7%	67.3%	65.5%	72.9%	69.2%	61.0%	62.7%	65.2%	67.7%	65.0%	64.0%	62.5%	61.4%	61.4%	61.9%
Average # of Visits by Type																
Therapy (OT, PT, speech)	3.7	5.7	5.8	7.3	5.2	6.0	7.8	8.5	3.8	4.9	4.8	6.1	4.9	5.3	5.9	7.0
Skilled nurse	7.0	6.5	7.6	7.4	6.2	5.7	8.6	7.9	7.3	6.7	8.1	7.8	7.0	7.0	8.4	7.9
Home health aide	1.6	1.0	2.3	1.7	1.0	0.9	1.5	1.1	1.7	1.2	2.7	1.9	0.9	0.7	2.0	1.4
Medical social services	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Persons aged ≥25 years with less than HS diploma in the beneficiary's county	17.3	17.1	18.7	18.7	14.1	17.4	12.3	11.9	18.5	17.9	18.7	18.4	19.6	18.5	14.4	14.1
Ownership																
For-profit	42.9%	67.2%	64.8%	70.4%	51.1%	55.9%	71.4%	71.7%	66.4%	63.1%	66.7%	71.2%	62.8%	67.0%	69.9%	71.4%
Non-profit	29.0%	13.6%	20.5%	20.3%	35.8%	34.3%	26.1%	26.2%	25.6%	31.5%	25.5%	23.0%	35.5%	31.4%	28.2%	27.2%

	HHVBP								Non-HHVBP							
	Rural				Urban				Rural				Urban			
	Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access	
	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post
Government-owned	28.1%	19.2%	14.7%	9.3%	13.1%	9.8%	2.5%	2.1%	8.0%	5.4%	7.8%	5.8%	1.7%	1.7%	1.9%	1.4%
Setting																
Hospital-based	28.8%	17.1%	18.2%	16.2%	22.8%	22.8%	7.8%	7.4%	13.6%	13.8%	17.2%	14.6%	19.0%	9.7%	10.4%	9.1%
Freestanding	71.2%	82.9%	81.8%	83.8%	77.2%	77.2%	92.2%	92.6%	86.4%	86.2%	82.8%	85.4%	81.0%	90.3%	89.6%	90.9%
Chain affiliation																
Chain affiliated	27.0%	45.9%	54.6%	57.5%	52.3%	44.2%	48.6%	53.5%	28.5%	29.3%	46.2%	52.1%	45.6%	36.6%	33.1%	37.6%
No chain affiliation	69.0%	50.1%	39.3%	36.6%	41.9%	54.1%	42.4%	39.1%	64.2%	62.2%	46.7%	42.5%	50.9%	58.8%	59.0%	55.4%
Chain affiliation unknown	2.1%	3.3%	5.2%	5.5%	1.0%	1.2%	5.7%	6.3%	4.3%	6.9%	4.5%	4.5%	1.9%	3.6%	5.9%	6.1%
Chain affiliation missing	2.0%	0.7%	0.9%	0.4%	4.8%	0.5%	3.2%	1.0%	3.0%	1.6%	2.7%	0.9%	1.6%	0.9%	2.0%	0.9%
HHA Age																
<4 years	14.9%	0.5%	2.1%	0.9%	5.2%	2.2%	7.5%	2.7%	3.1%	2.4%	2.6%	1.5%	5.5%	4.6%	7.3%	3.9%
4-10 years	4.0%	18.2%	8.3%	8.6%	6.9%	10.3%	26.4%	19.7%	18.8%	10.4%	12.6%	8.3%	21.6%	21.6%	25.3%	20.1%
>10 years	81.1%	81.3%	89.6%	90.5%	87.9%	87.6%	66.0%	77.6%	78.1%	87.2%	84.8%	90.2%	72.9%	73.8%	67.5%	76.0%
Agency Size																
1-59 OASIS Episodes	10.9%	1.8%	1.7%	1.2%	0.3%	0.1%	1.3%	0.8%	3.0%	1.0%	2.0%	1.4%	1.1%	1.0%	3.6%	2.5%

	HHVBP								Non-HHVBP							
	Rural				Urban				Rural				Urban			
	Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access		Low Access (ED)		Not Low Access	
	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post	Base	Post
60-249 OASIS Episodes	25.5%	9.5%	11.0%	9.9%	4.8%	2.7%	7.3%	4.6%	24.5%	17.1%	16.4%	12.6%	10.1%	12.2%	15.5%	12.3%
250-499 OASIS Episodes	30.3%	23.6%	14.1%	12.0%	30.0%	17.5%	10.9%	7.9%	22.6%	22.0%	18.5%	15.8%	15.1%	16.7%	14.3%	12.2%
500-999 OASIS Episodes	15.3%	18.3%	20.2%	16.2%	45.9%	25.5%	16.8%	14.6%	20.7%	18.6%	21.5%	22.4%	19.5%	18.3%	16.2%	15.4%
1000+ OASIS Episodes	18.1%	46.8%	53.0%	60.6%	18.9%	54.2%	63.7%	72.1%	29.1%	41.2%	41.6%	47.8%	54.2%	51.8%	50.4%	57.5%

Base: Baseline Period (2013-2015), Post: Post Period (2016-2019)

C.3.5 Substitutes to Home Health Care Supporting Analyses

Exhibit C-15. Additional Characteristics of Medicare FFS Beneficiary Acute Care Hospitalization Discharges, Baseline and Post-HHVBP Performance Period

Characteristics of Acute Care Hospitalization Discharges	HHVBP States		Non-HHVBP States	
	Baseline (2013-2015)	Post Period (2016-2019)	Baseline (2013-2015)	Post Period (2016-2019)
APM Flags				
BPCI2	1.8%	3.8%	1.8%	3.3%
BPCI3	0.1%	0.3%	0.2%	0.3%
BPCI Advanced*	N/A	2.1%	N/A	2.5%
ACO SSP	19.0%	30.7%	16.2%	29.5%
ACO Next Generation*	N/A	6.2%	0.0%	3.3%
ACO Pioneer*	4.2%	0.8%	2.0%	0.2%
CJR*	N/A	0.9%	N/A	1.0%
OCM*	N/A	2.3%	N/A	2.2%
Select Hierarchical Condition Categories				
Protein-Calorie Malnutrition	5.7%	7.0%	6.7%	8.0%
Other Significant Endocrine and Metabolic Disorders	4.0%	4.5%	3.9%	4.4%
Dementia Without Complication	13.5%	12.8%	13.4%	12.5%
Drug/Alcohol Dependence	2.5%	3.1%	2.1%	2.5%
Parkinson's and Huntington's Diseases	1.9%	2.4%	2.0%	2.4%
Seizure Disorders and Convulsions	4.9%	4.9%	5.2%	5.2%
Congestive Heart Failure	27.7%	29.4%	29.3%	31.0%
Specified Heart Arrhythmias	27.7%	30.1%	26.8%	29.3%
Atherosclerosis of the Extremities with Ulceration or Gangrene	1.0%	1.0%	1.1%	1.1%
Pressure Ulcer of Skin with Partial Thickness Skin Loss	1.0%	1.1%	1.2%	1.2%
Hip Fracture/Dislocation	3.2%	3.2%	3.1%	3.1%
Complications of Specified Implanted Device or Graft	2.9%	3.6%	2.9%	3.5%

Exhibit C-16. Unadjusted Annual Means (and Standard Errors) for Post-Acute Care for FFS Medicare Beneficiaries within 14 Days following Hospital Discharge 2013 – 2019, HHVBP States

Post-Acute Care Type	2013	2014	2015	2016	2017	2018	2019
Home Health Care	22.6% (0.0307)	22.6% (0.0308)	22.6% (0.0304)	22.8% (0.0305)	22.8% (0.0304)	23.0% (0.0308)	22.9% (0.0311)
Skilled Nursing Facility	24.4% (0.0315)	24.7% (0.0318)	24.4% (0.0312)	23.7% (0.0309)	23.2% (0.0306)	22.9% (0.0308)	22.4% (0.0309)
Inpatient Rehabilitation Facility	3.1% (0.0127)	3.2% (0.0130)	3.2% (0.0129)	3.3% (0.0129)	3.3% (0.0130)	3.4% (0.0133)	3.5% (0.0136)
Self-Care	39.2% (0.0358)	38.6% (0.0359)	38.6% (0.0354)	38.9% (0.0354)	39.1% (0.0353)	39.0% (0.0357)	39.2% (0.0362)
Hospital Outpatient Therapy	2.1% (0.0105)	2.1% (0.0106)	2.3% (0.0109)	2.4% (0.0112)	2.5% (0.0114)	2.6% (0.0116)	2.7% (0.0119)

*HHVBP Measures indicated by italic text. Standard Errors are expressed in the same units as that of the corresponding measures. * Values listed as "N/A" reflect years where the APM is not active.*

Exhibit C-17. Unadjusted Annual Means (and Standard Errors) for Post-Acute Care for FFS Medicare Beneficiaries within 14 Days following Hospital Discharge 2013 – 2019, Non-HHVBP States

Post-Acute Care Type	2013	2014	2015	2016	2017	2018	2019
Home Health Care	21.9% (0.0169)	22.0% (0.0171)	22.0% (0.0169)	22.2% (0.0169)	22.3% (0.0169)	22.0% (0.0170)	21.9% (0.0172)
Skilled Nursing Facility	23.8% (0.0174)	24.2% (0.0176)	23.9% (0.0174)	23.4% (0.0172)	23.0% (0.0171)	22.8% (0.0172)	22.2% (0.0173)
Inpatient Rehabilitation Facility	3.9% (0.0079)	4.0% (0.0081)	4.0% (0.0080)	4.0% (0.0079)	3.9% (0.0079)	4.1% (0.0081)	4.2% (0.0083)
Self-Care	39.2% (0.0199)	38.5% (0.0201)	38.6% (0.0198)	38.9% (0.0198)	39.1% (0.0198)	39.2% (0.0200)	39.4% (0.0204)
Hospital Outpatient Therapy	2.3% (0.0061)	2.3% (0.0061)	2.4% (0.0063)	2.6% (0.0064)	2.7% (0.0066)	2.8% (0.0067)	2.9% (0.0070)

HHVBP Measures indicated by italic text. Standard Errors are expressed in the same units as that of the corresponding measures

Exhibit C-18. Sensitivity Impact of HHVBP on Use of Alternative Post-Acute Care Options with Expanded Covariate List

	Model Estimates				Average in HHVBP States, Baseline (2013-2015)	% Relative Change
	D-in-D[a]	p-value	Lower 90% CI[a]	Upper 90% CI[a]		
Home Health Care						
2016	0.08	0.50	-0.11	0.26	22.6%	0.4%
2017	0.18	0.30	-0.11	0.47		0.8%
2018	0.52	0.03	0.13	0.92		2.3%
2019	0.76	0.01	0.26	1.26		3.4%
Cumulative	0.38	0.05	0.06	0.70		1.7%
Skilled Nursing Facility						
2016	-0.24	0.02	-0.40	-0.07	24.5%	-1.0%
2017	-0.31	0.04	-0.55	-0.06		-1.3%
2018	-0.21	0.31	-0.54	0.13		-0.9%
2019	-0.14	0.59	-0.57	0.28		-0.6%
Cumulative	-0.22	0.18	-0.50	0.05		-0.9%
Inpatient Rehabilitation Facility						
2016	0.01	0.82	-0.07	0.09	3.2%	0.3%
2017	0.07	0.36	-0.06	0.21		2.5%
2018	-0.03	0.80	-0.21	0.15		-0.9%
2019	-0.08	0.57	-0.31	0.15		-2.5%
Cumulative	-0.004	0.96	-0.15	0.14		-0.1%
Self-care						
2016	0.10	0.44	-0.11	0.31	38.8%	0.3%
2017	0.09	0.67	-0.25	0.43		0.2%
2018	-0.23	0.43	-0.71	0.25		-0.6%
2019	-0.42	0.24	-1.00	0.16		-1.1%
Cumulative	-0.11	0.63	-0.49	0.27		-0.3%
Hospital Outpatient Therapy						
2016	0.02	0.53	-0.03	0.08	2.2%	0.9%
2017	-0.01	0.88	-0.08	0.07		-0.5%

	Model Estimates				Average in HHVBP States, Baseline (2013-2015)	% Relative Change
	D-in-D[a]	p-value	Lower 90% CI[a]	Upper 90% CI[a]		
2018	-0.02	0.78	-0.12	0.08		-0.9%
2019	-0.11	0.18	-0.24	0.02		-5.0%
Cumulative	-0.03	0.59	-0.11	0.06		-1.4%

[a] *Values represent percentage point changes. | CI = Confidence Interval.*

C.4 Home Health Agency Structure and Practices Supporting Analyses

Exhibit C-19. Unadjusted Annual Means (and Standard Errors ††) for Frontloading Measures 2013 – 2019, HHVBP States

Measure	2013	2014	2015	2016	2017	2018	2019
Number of Skilled Nurse Visits During First 2 Weeks	4.06 (0.0054)	3.92 (0.0053)	3.82 (0.0052)	3.76 (0.0052)	3.65 (0.0049)	3.61 (0.0049)	3.58 (0.0053)
Number of Therapist Visits During First 2 Weeks	3.95 (0.0065)	3.92 (0.0053)	3.97 (0.0063)	4.09 (0.0063)	4.16 (0.006)	4.20 (0.0061)	4.19 (0.0064)
Frontloading Skilled Nurse Visits	62.44% (0.1034)	61.21% (0.1052)	59.99% (0.1047)	58.88% (0.1051)	57.93% (0.1033)	57.04% (0.1052)	56.38% (0.1130)
Frontloading Therapist Visits	30.71% (0.0985)	30.86% (0.0997)	30.83% (0.0987)	31.93% (0.0996)	32.55% (0.0980)	32.63% (0.0996)	32.82% (0.1070)

Trends displayed above represent a subset of claims-based episodes, only including post-institutional episodes which lasted at least 14 days without a hospitalization occurring during that time.†† Standard Errors are reported in the same units as the corresponding measure means.

Exhibit C-20. Unadjusted Annual Means (and Standard Errors) for Frontloading Measures 2013 – 2019, Non-HHVBP States*

Measure	2013	2014	2015	2016	2017	2018	2019
Number of Skilled Nurse Visits During First 2 Weeks	3.90 (0.0027)	3.80 (0.0027)	3.70 (0.0026)	3.61 (0.0026)	3.51 (0.0025)	3.44 (0.0025)	3.37 (0.0026)
Number of Therapist Visits During First 2 Weeks	3.63 (0.0035)	3.71 (0.0035)	3.75 (0.0035)	3.87 (0.0035)	3.97 (0.0034)	3.99 (0.0034)	4.03 (0.0036)
Frontloading Skilled Nurse Visits	62.68% (0.0581)	61.75% (0.0591)	61.03% (0.0588)	60.00% (0.0587)	58.89% (0.0582)	57.76% (0.0595)	56.50% (0.0633)
Frontloading Therapist Visits	27.91% (0.0539)	28.58% (0.0550)	28.97% (0.0547)	29.36% (0.0546)	30.02% (0.0543)	29.72% (0.0551)	30.05% (0.0586)

*Trends displayed above represent a subset of claims-based episodes, only including post-institutional episodes which lasted at least 14 days without a hospitalization occurring during that time. *Standard Errors are reported in the same units as the corresponding measure means.*

C.5 TPS and Payment Adjustment Supporting Analyses

C.5.1 TPS Supporting Analyses

Exhibit C-21. Characteristics of HHAs by Eligibility for Calculating a TPS Score in 2019

HHA Characteristics	Agencies in HHVBP States			Agencies in Non-Model States		
	Eligible for TPS		Total	Eligible for TPS		Total
	Yes	No		Yes	No	
Total number of HHAs	1,545	386	1,931	6,273	2,474	8,747
HHA Size: Number of OASIS Episodes (%)						
1-59	4.5%	85.4%	20.1%	4.8%	85.1%	27.0%
60-249	25.1%	12.5%	22.7%	34.7%	12.3%	28.5%
250-499	20.0%	1.6%	16.5%	21.0%	1.6%	15.6%
500-999	18.4%	0.5%	14.9%	17.6%	0.8%	12.9%
≥1,000	32.0%	0.0%	25.9%	21.9%	0.1%	15.9%
Ownership (%)						
For-profit	77.0%	89.1%	79.4%	79.1%	91.7%	82.7%
Non-profit	17.5%	5.2%	15.1%	17.3%	6.5%	14.2%
Government-owned	5.5%	5.7%	5.5%	3.6%	1.8%	3.1%
Setting (%)						
Hospital-based	8.2%	2.3%	7.0%	8.9%	2.1%	7.0%
Freestanding	91.8%	97.7%	93.0%	91.1%	97.9%	93.0%
Chain affiliation (%)						
Chain=Yes	39.0%	9.1%	33.0%	25.1%	6.3%	19.8%
Chain=No	57.2%	82.4%	62.2%	71.6%	86.9%	75.9%
Chain=Missing/Unknown	3.8%	8.5%	4.8%	3.3%	6.9%	4.3%
HHA years in operation (%)						
<4 years	2.6%	24.2%	6.9%	4.2%	21.8%	9.2%
4-10 years	30.2%	34.4%	31.1%	26.6%	36.3%	29.4%
>10 years	67.2%	41.4%	62.1%	69.2%	41.8%	61.5%

Exhibit C-22. HHA Eligibility for Calculating a TPS Score in 2018

	Agencies in HHVBP States			Agencies in Non-HHVBP States		
	Eligible for TPS		Total	Eligible for TPS		Total
	Yes	No		Yes	No	
Total number of HHAs	1,622	361	1,983	6,779	2,165	8,944
% of HHAs	81.8%	18.2%	100.0%	75.8%	24.2%	100.0%
Number of OASIS episodes	1,661,359	12,944	1,674,303	5,513,774	93,595	5,607,369
% of OASIS episodes	99.2%	0.8%	100.0%	98.3%	1.7%	100.0%
Number of Medicare claims episodes	1,400,111	11,446	1,411,557	4,703,445	113,077	4,816,522

	Agencies in HHVBP States			Agencies in Non-HHVBP States		
	Eligible for TPS		Total	Eligible for TPS		Total
	Yes	No		Yes	No	
% of Medicare claims episodes	99.2%	0.8%	100.0%	97.7%	2.3%	100.0%

Exhibit C-23. Characteristics of HHAs by Eligibility for Calculating a TPS Score in 2018

HHA Characteristics	Agencies in HHVBP States			Agencies in Non-Model States		
	Eligible for TPS		Total	Eligible for TPS		Total
	Yes	No		Yes	No	
Total number of HHAs	1,622	361	1,983	6,779	2,165	8,944
HHA Size: Number of OASIS Episodes (%)						
1-59	6.4%	85.8%	20.1%	7.6%	86.2%	26.0%
60-249	25.6%	11.5%	23.2%	36.2%	10.8%	30.2%
250-499	19.6%	2.4%	16.6%	19.8%	2.0%	15.6%
500-999	17.8%	0.0%	14.7%	16.3%	0.6%	12.6%
≥1,000	30.5%	0.3%	25.3%	20.1%	0.4%	15.5%
Ownership (%)						
For-profit	76.9%	89.2%	79.2%	79.4%	90.3%	82.0%
Non-profit	17.4%	6.4%	15.4%	16.9%	7.4%	14.6%
Government-owned	5.7%	4.4%	5.4%	3.7%	2.3%	3.4%
Setting (%)						
Hospital-based	9.1%	1.9%	7.8%	8.9%	2.3%	7.3%
Freestanding	90.9%	98.1%	92.2%	91.1%	97.7%	92.7%
Chain affiliation (%)						
Chain=Yes	36.3%	6.9%	31.0%	23.0%	7.0%	19.2%
Chain=No	60.0%	83.7%	64.3%	73.5%	86.1%	76.6%
Chain=Missing/Unknown	3.6%	9.4%	4.7%	3.4%	6.9%	4.3%
HHA years in operation (%)						
<4 years	5.4%	30.7%	10.0%	4.6%	23.1%	9.1%
4-10 years	31.3%	29.9%	31.0%	30.4%	37.5%	32.1%
>10 years	63.3%	39.3%	59.0%	65.0%	39.4%	58.8%

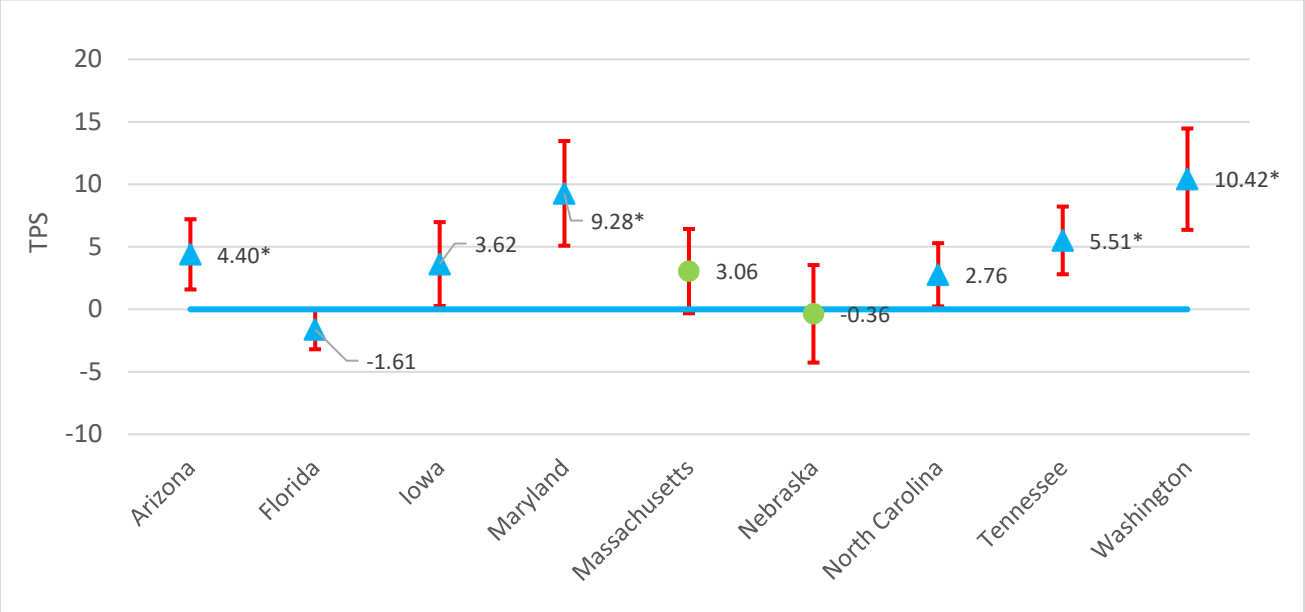
Exhibit C-24. Average Measure Scores among Agencies in HHVBP and Non-HHVBP States, 2016 – 2019

HHVBP Performance Measure	2016		2017		2018		2019	
	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP	HHVBP	Non-HHVBP
ED Use (no Hospitalization)/First FFS HH Episodes	2.3	2.5	2.2	2.3	2.2	2.4	2.0	2.2
Unplanned Acute Care Hospitalization/First FFS HH Episodes	2.2	2.2	2.7	2.8	2.9	2.9	3.0	2.8
Discharged to Community	2.9	2.6	2.8	2.5	3.1	2.7	3.3	3.0
Improvement in Ambulation-Locomotion‡	4.5	3.9	5.7	5.0	6.5	5.9	N/A	N/A
Improvement in Bathing‡	4.2	3.6	5.3	4.4	6.0	5.1	N/A	N/A
Improvement in Bed Transferring‡	4.5	3.9	6.5	5.4	7.5	6.5	N/A	N/A
Improvement in Management of Oral Medications	4.2	3.6	5.8	4.9	6.7	5.9	7.9	7.1
Improvement in Dyspnea	4.0	3.6	5.3	4.6	6.0	5.3	6.7	6.1
Improvement in Pain Interfering with Activity	4.2	3.7	5.2	4.5	5.7	5.1	6.4	5.9
TNC Change in Self-Care	N/A	N/A	N/A	N/A	N/A	N/A	7.5	6.4
TNC Change in Mobility	N/A	N/A	N/A	N/A	N/A	N/A	8.1	6.9
Drug Education on Medications Provided to Patient/Caregiver during Episodes of Care†	5.7	5.2	6.1	5.7	N/A	N/A	N/A	N/A
Influenza Immunization Received for Current Flu Season‡	4.6	4.4	4.8	4.9	5.0	5.1	N/A	N/A
Pneumococcal Polysaccharide Vaccine Ever Received‡	4.6	4.6	4.7	4.9	4.8	5.1	N/A	N/A
How often the home health team gave care in a professional way	2.5	2.7	2.5	2.7	2.7	2.8	2.5	2.7
How well did the home health team communicate with patients	2.8	2.9	2.8	2.8	3.0	3.0	2.8	2.9
Did the home health team discuss medicines, pain, and home safety with patients	2.6	2.8	2.8	2.9	2.8	2.9	2.6	2.7
How do patients rate the overall care from the home health agency	2.8	2.9	2.7	2.8	2.8	2.8	2.8	2.8
Would patients recommend the home health agency to friends and family	2.6	2.7	2.5	2.6	2.6	2.6	2.5	2.5
TPS	**37.1**	**34.9**	**42.6**	**40.0**	**45.4**	**42.9**	**38.9**	**36.6**

†*This measure was dropped for performance year 2018 and all subsequent years of the HHVBP Model and dropped from the CMS Star Ratings in April 2019.*

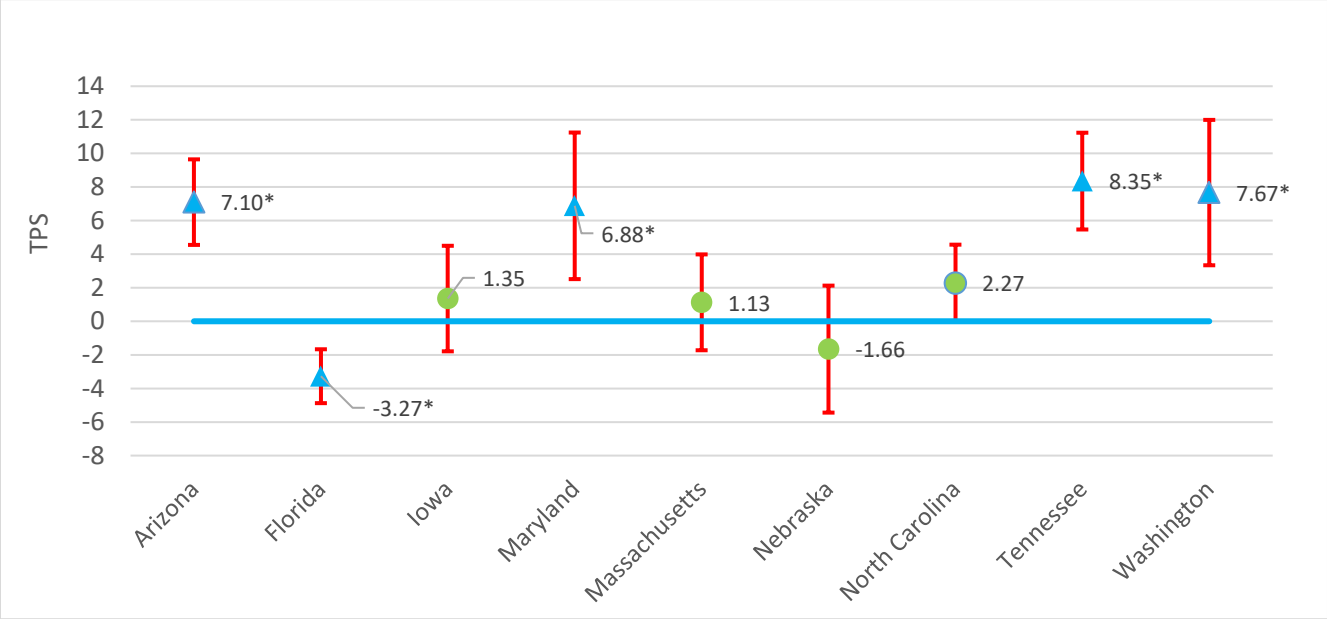
‡ *These measures were dropped for performance year 2019 and all subsequent years of the HHVBP Model.*

Exhibit C-25. Difference in Agency TPS Scores between HHVBP States and their Regional Comparison Groups, 2016



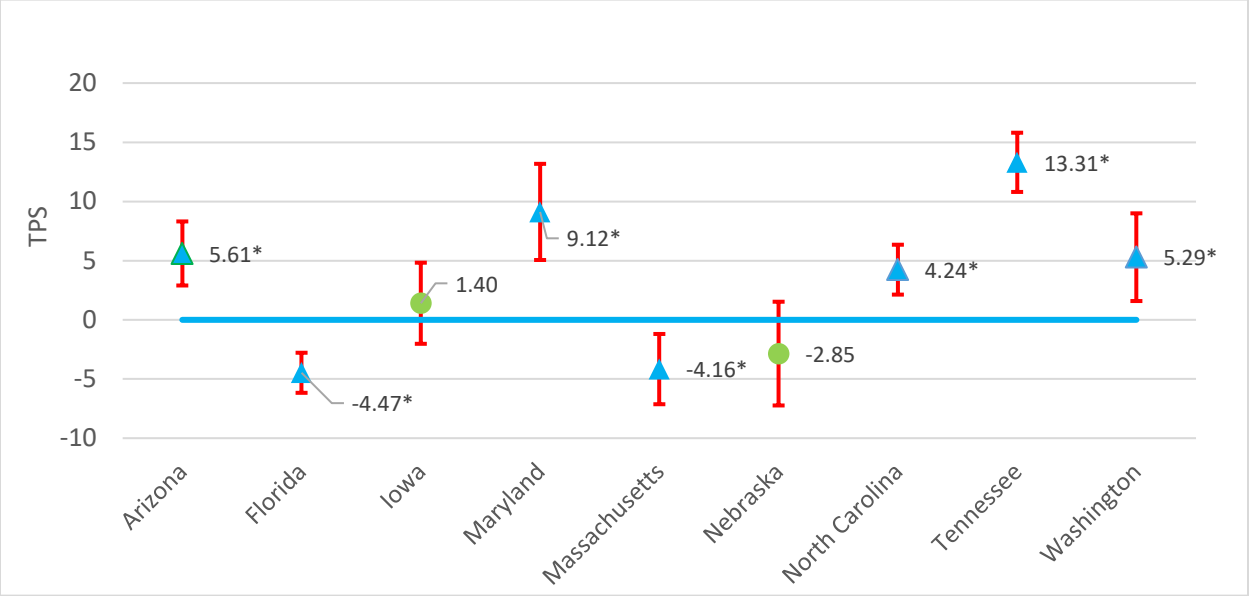
*Blue triangle signifies statistical significance of p < 0.1; *p < 0.05*

Exhibit C-26. Difference in Agency TPS Scores between HHVBP States and their Regional Comparison Groups, 2017



*Blue triangle signifies statistical significance of p < 0.1; *p < 0.05*

Exhibit C-27. Difference in Agency TPS Scores between HHVBP States and their Regional Comparison Groups, 2018



*Blue triangle signifies statistical significance of p < 0.1; * p < 0.05*

C.5.2 HHA Profitability Supporting Analyses

Exhibit C-28. Distribution of HHA Profit Margins in 2013 – 2018, by Year, All HHVBP States, and All Non-HHVBP States

	HHVBP							Non-HHVBP						
	2013-2015	2013	2014	2015	2016	2017	2018	2013-2015	2013	2014	2015	2016	2017	2018
Profitability*														
Profit margin <0%	26.2%	26.7%	27.4%	24.3%	23.3%	25.3%	27.0%	31.7%	30.8%	31.9%	25.7%	25.6%	25.2%	24.3%
Profit margin 0-10%	16.0%	17.2%	16.6%	14.0%	13.1%	13.2%	13.7%	17.9%	19.2%	18.2%	16.7%	16.9%	16.2%	15.9%
Profit margin >10%	57.8%	56.1%	56.0%	61.6%	63.6%	61.5%	59.3%	50.4%	50.0%	49.9%	57.6%	57.5%	58.6%	59.7%

These numbers reflect all HHAs with at least one OASIS episode or Medicare claims episode in a given year, regardless if the HHA received a TPS in 2018.

** The number of HHAs used to calculate profitability margins is a subset of all HHAs, given incomplete and/or missing Medicare Cost Report data and the trimming methodology employed to calculate the variable (See Section A.2.1.3 for more detail). For example, among the 2,413 HHVBP and 9,869 non-HHVBP HHAs in 2013, only 1,571 and 6,727, respectively, had Cost Report data that could be used to estimate profitability.*

C.5.3 Payment Adjustment Supporting Analyses

Exhibit C-29. Distribution of CY 2018 HHA Payment Adjustments across HHA Characteristics

	N	Minimum	25th percentile	Mean	Median	75th percentile	Maximum
All	1,622	-2.58	-0.77	0.00	-0.08	0.65	3.00
Type							
Freestanding	1,459	-2.58	-0.77	0.00	-0.09	0.66	3.00
Hospital-based	163	-1.86	-0.80	-0.06	-0.03	0.48	2.44
Ownership							
For profit	1,210	-2.58	-0.78	0.00	-0.10	0.65	3.00
Nonprofit	301	-2.23	-0.66	0.07	0.04	0.77	3.00
Government owned	111	-1.87	-0.84	-0.19	-0.29	0.21	2.44
Chain Affiliation							
Yes	570	-2.10	-0.56	0.03	0.00	0.60	2.97
No	975	-2.58	-0.88	-0.02	-0.15	0.73	3.00
Missing/Unknown	77	-2.05	-0.88	-0.04	-0.08	0.78	3.00
Size: Number of OASIS Episodes							
1-59	94	-2.58	-0.96	0.06	-0.08	1.15	3.00
60-249	458	-2.55	-0.88	0.12	-0.05	0.94	3.00
250-499	319	-2.25	-0.82	0.02	0.01	0.80	3.00
500-999	303	-2.30	-0.68	-0.06	-0.10	0.56	2.72
1000+	448	-2.07	-0.68	-0.12	-0.13	0.46	2.22
HHA Age							
<4 years	138	-2.55	-1.26	-0.17	-0.31	0.74	3.00
4-10 years	538	-2.30	-0.72	0.16	0.06	0.88	3.00
>10 years	946	-2.58	-0.75	-0.07	-0.11	0.53	3.00

HHA characteristics from CY 2016. HHA size determined by number of OASIS episodes in CY 2016.

Exhibit C-30. Distribution of CY 2019 HHA Payment Adjustments across HHA Characteristics

	N	Minimum	25th percentile	Mean	Median	75th percentile	Maximum
All	1,616	-5.00	-1.18	-0.11	-0.09	0.93	4.96
Type							
Freestanding	1,466	-5.00	-1.20	-0.10	-0.09	0.95	4.96
Hospital-based	150	-3.93	-1.05	-0.16	-0.12	0.60	4.41
Ownership							
For profit	1,228	-5.00	-1.23	-0.12	-0.11	0.98	4.96
Nonprofit	287	-2.87	-0.88	0.02	0.01	0.79	4.41
Government owned	101	-3.93	-1.41	-0.32	-0.26	0.62	3.77
Chain Affiliation							
Yes	575	-3.79	-0.69	0.11	0.13	0.92	3.53
No	973	-5.00	-1.42	-0.22	-0.33	0.96	4.96
Missing/Unknown	68	-3.09	-1.56	-0.36	-0.32	0.53	3.25
Size: Number of OASIS Episodes							
1-59	97	-4.95	-1.78	-0.18	-0.29	1.30	4.92
60-249	427	-4.73	-1.51	-0.08	-0.24	1.29	4.96
250-499	313	-5.00	-1.18	-0.08	-0.13	1.18	4.62
500-999	310	-3.79	-0.96	-0.06	0.01	0.96	3.81
1000+	469	-3.82	-0.90	-0.17	-0.11	0.64	2.44
HHA Age							
<4 years	118	-4.38	-2.26	-0.61	-0.81	0.93	3.57
4-10 years	523	-5.00	-1.22	0.02	0.01	1.23	4.96
>10 years	975	-4.95	-1.05	-0.12	-0.09	0.80	4.56

HHA characteristics from CY 2017. HHA size determined by number of OASIS episodes in CY 2017.

Exhibit C-31. Distribution of CY 2020 HHA Payment Adjustments across HHA Characteristics

	N	Minimum	25th percentile	Mean	Median	75th percentile	Maximum
All	1,606	-5.61	-1.20	-0.07	-0.04	1.06	6.00
Type							
Freestanding	1,461	-5.61	-1.21	-0.06	-0.03	1.07	6.00
Hospital-based	145	-4.46	-1.18	-0.21	-0.14	0.97	3.43
Ownership							
For profit	1,236	-5.61	-1.27	-0.07	-0.04	1.13	6.00
Nonprofit	280	-4.88	-0.86	0.02	0.05	0.88	6.00
Government owned	90	-4.35	-1.72	-0.44	-0.62	0.75	5.65
Chain Affiliation							
Yes	588	-4.46	-0.68	0.05	0.09	0.86	3.89
No	959	-5.61	-1.77	-0.15	-0.18	1.33	6.00
Missing/Unknown	59	-3.69	-0.63	0.03	0.16	0.97	6.00
Size: Number of OASIS Episodes							
1-59	101	-5.10	-2.26	0.14	0.06	2.34	6.00
60-249	408	-5.61	-1.79	0.02	-0.08	1.92	6.00
250-499	315	-5.41	-1.59	-0.12	-0.06	1.26	5.30
500-999	287	-5.14	-0.99	-0.01	0.14	1.06	5.86
1000+	495	-5.01	-0.81	-0.20	-0.08	0.57	2.44
HHA Age							
<4 years	86	-5.12	-2.64	-0.40	-0.48	1.75	6.00
4-10 years	501	-5.61	-1.43	0.03	0.01	1.53	6.00
>10 years	1019	-5.56	-1.08	-0.10	-0.05	0.89	6.00

HHA characteristics from CY 2018. HHA size determined by number of OASIS episodes in CY 2018.

C.6 Utilization of Services Supporting Analyses

Exhibit C-32. Impact of the HHVBP Model between early years (2016 – 2017) vs. later years of HHVBP (2018 – 2019) for Claims-Based Utilization Measures

Measure	D-in-D[a]	p-value	Lower 90% CI[a]	Upper 90% CI[a]
Unplanned Acute Care Hospitalization/First FFS HH Episodes	-0.03	0.59	-0.14	0.07
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes	0.13	0.03	0.03	0.24
ED Use followed by Inpatient Admission/First FFS HH Episodes	-0.03	0.68	-0.14	0.08
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes	0.14	0.10	0.001	0.28
Unplanned Acute Care Hospitalization/All FFS HH Episodes	-0.06	0.31	-0.16	0.04
SNF Use/All FFS HH Episodes	-0.06	0.05	-0.11	-0.01

[a] *Values represent percentage point changes.*

C.6.1 Cause of Hospitalization Supporting Analyses

Exhibit C-33. Unadjusted Annual Means (and Standard Errors[†]) for FFS Claims-Based Utilization Measures by Major Diagnostic Categories, 2013 – 2019, HHVBP States

Measure	2013	2014	2015	2016	2017	2018	2019
Unplanned Acute Care Hospitalization with Circulatory System Diagnosis/First FFS HH Episodes	3.5% (0.0211)	3.5% (0.0214)	3.4% (0.0214)	3.2% (0.0207)	3.2% (0.0210)	3.2% (0.0211)	3.2% (0.0212)
Unplanned Acute Care Hospitalization with Musculoskeletal System Diagnosis /First FFS HH Episodes	1.4% (0.0135)	1.5% (0.0141)	1.5% (0.0141)	1.4% (0.0137)	1.4% (0.0140)	1.4% (0.0140)	1.4% (0.0142)
Unplanned Acute Care Hospitalization with Digestive System Diagnosis/First FFS HH Episodes	1.6% (0.0146)	1.6% (0.0148)	1.6% (0.0148)	1.5% (0.0144)	1.5% (0.0144)	1.4% (0.0142)	1.4% (0.0142)
Unplanned Acute Care Hospitalization with Kidney and Urinary Tract Diagnosis/First FFS HH Episodes	1.5% (0.0139)	1.5% (0.0143)	1.6% (0.0148)	1.7% (0.0153)	1.7% (0.0154)	1.7% (0.0155)	1.7% (0.0154)
Unplanned Acute Care Hospitalization Respiratory System Diagnosis/First FFS HH Episodes	2.5% (0.0179)	2.4% (0.0181)	2.4% (0.0180)	2.3% (0.0179)	2.5% (0.0185)	2.2% (0.0176)	2.2% (0.0176)
Unplanned Acute Care Hospitalization Nervous System Diagnosis/First FFS HH Episodes	1.1% (0.0123)	1.1% (0.0124)	1.2% (0.0127)	1.2% (0.0128)	1.2% (0.0130)	1.2% (0.0130)	1.2% (0.0132)
Unplanned Acute Care Hospitalization with Infectious and Parasitic Diagnosis/First FFS HH Episodes	1.2% (0.0125)	1.3% (0.0135)	1.5% (0.0142)	1.6% (0.0148)	1.7% (0.0155)	1.8% (0.0158)	1.8% (0.0160)

Measure	2013	2014	2015	2016	2017	2018	2019
Unplanned Acute Care Hospitalization with Other Major Diagnostic Categories/First FFS HH Episodes	3.1% (0.0200)	3.1% (0.0204)	2.9% (0.0198)	2.8% (0.0194)	2.8% (0.0195)	2.7% (0.0194)	2.8% (0.0198)
Medical Type Unplanned Acute Hospitalization/First FFS HH Episodes	13.0% (0.0388)	13.3% (0.0398)	13.5% (0.0402)	13.6% (0.0405)	13.9% (0.0412)	13.7% (0.0410)	13.5% (0.0412)
Surgical Type Unplanned Acute Hospitalization/First FFS HH Episodes	2.6% (0.0184)	2.6% (0.0186)	2.5% (0.0183)	2.0% (0.0168)	2.0% (0.0169)	2.1% (0.0169)	2.1% (0.0173)
Rehospitalization (overall)	19.5% (0.0727)	19.6% (0.0735)	19.0% (0.0719)	18.1% (0.0702)	18.4% (0.0702)	18.5% (0.0712)	18.5% (0.0723)
Medical Rehospitalization for Same MDC as Index Hospitalization	6.5% (0.0911)	6.6% (0.0911)	6.5% (0.0895)	6.7% (0.0920)	6.9% (0.0895)	6.6% (0.0862)	6.6% (0.0802)
Medical Rehospitalization for Different MDC as Index Hospitalization	16.6% (0.0878)	16.8% (0.0890)	16.5% (0.0871)	15.7% (0.0863)	15.9% (0.0856)	15.9% (0.0861)	15.8% (0.0869)

[†] *Standard Errors are reported in the same units as the corresponding measure means.*

Exhibit C-34. Unadjusted Annual Means (and Standard Errors[†]) for FFS Claims-Based Utilization Measures by Major Diagnostic Categories, 2013 – 2019, Non-HHVBP States

Measure	2013	2014	2015	2016	2017	2018	2019
Unplanned Acute Care Hospitalization with Circulatory System Diagnosis/First FFS HH Episodes	3.7% (0.0131)	3.6% (0.0130)	3.4% (0.0127)	3.2% (0.0121)	3.2% (0.0123)	3.2% (0.0123)	3.2% (0.0125)
Unplanned Acute Care Hospitalization with Musculoskeletal System Diagnosis /First FFS HH Episodes	1.4% (0.0082)	1.5% (0.0084)	1.4% (0.0082)	1.3% (0.0079)	1.3% (0.0079)	1.3% (0.0080)	1.4% (0.0082)
Unplanned Acute Care Hospitalization with Digestive System Diagnosis/First FFS HH Episodes	1.7% (0.0089)	1.6% (0.0088)	1.6% (0.0086)	1.5% (0.0083)	1.4% (0.0083)	1.4% (0.0082)	1.4% (0.0082)
Unplanned Acute Care Hospitalization with Kidney and Urinary Tract Diagnosis/First FFS HH Episodes	1.5% (0.0084)	1.5% (0.0085)	1.6% (0.0087)	1.7% (0.0089)	1.7% (0.0088)	1.7% (0.0089)	1.6% (0.0090)
Unplanned Acute Care Hospitalization Respiratory System Diagnosis/First FFS HH Episodes	2.6% (0.0110)	2.5% (0.0109)	2.4% (0.0107)	2.4% (0.0105)	2.4% (0.0106)	2.2% (0.0103)	2.2% (0.0103)
Unplanned Acute Care Hospitalization Nervous System Diagnosis/First FFS HH Episodes	1.2% (0.0075)	1.2% (0.0075)	1.2% (0.0075)	1.2% (0.0075)	1.2% (0.0075)	1.2% (0.0075)	1.2% (0.0077)
Unplanned Acute Care Hospitalization with Infectious and Parasitic Diagnosis/First FFS HH Episodes	1.4% (0.0081)	1.5% (0.0085)	1.7% (0.0089)	1.8% (0.0091)	1.9% (0.0094)	1.9% (0.0095)	1.9% (0.0097)
Unplanned Acute Care Hospitalization with Other Major Diagnostic Categories/First FFS HH Episodes	3.4% (0.0126)	3.3% (0.0124)	3.0% (0.0119)	2.8% (0.0115)	2.8% (0.0114)	2.8% (0.0114)	2.8% (0.0116)
Medical Type Unplanned Acute Hospitalization/First FFS HH Episodes	13.7% (0.0239)	13.7% (0.0239)	13.7% (0.0239)	13.7% (0.0237)	13.9% (0.0239)	13.6% (0.0239)	13.6% (0.0242)
Surgical Type Unplanned Acute Hospitalization/First FFS HH Episodes	2.8% (0.0114)	2.8% (0.0114)	2.5% (0.0109)	2.1% (0.0100)	2.1% (0.0098)	2.1% (0.0100)	2.1% (0.0102)
Rehospitalization (overall)	20.0% (0.0417)	19.8% (0.0421)	19.1% (0.0412)	18.4% (0.0402)	18.4% (0.0402)	18.6% (0.0411)	18.8% (0.0420)
Medical Rehospitalization for Same MDC as Index Hospitalization	6.3% (0.0501)	6.3% (0.0505)	6.3% (0.0503)	6.6% (0.0513)	6.6% (0.0504)	6.6% (0.0489)	6.5% (0.0455)
Medical Rehospitalization for Different MDC as Index Hospitalization	16.8% (0.0494)	16.9% (0.0502)	16.5% (0.0494)	15.8% (0.0489)	16.0% (0.0490)	15.9% (0.0492)	16.1% (0.0504)

[†] *Standard Errors are reported in the same units as the corresponding measure means.*

C.7 Medicare Spending Supporting Analyses

Exhibit C-35. Average Number of Days in Baseline and Post-HHVBP Performance Periods for FFS-Claims Based Spending Measures, All HHVBP States and Non-HHVBP States

Measure	HHVBP States, Baseline (2013-2015)	Non-HHVBP States, Baseline (2013-2015)	HHVBP States, Post-HHVBP (2016-2019)	Non-HHVBP States, Post-HHVBP (2016-2019)
Average Medicare Spending per Day during and following FFS HH Episodes of Care	64.8	64.5	65.2	65.0
Average Medicare Spending per Day during FFS HH Episodes of Care	45.9	48.9	46.1	48.4
Average Medicare Spending per Day following FFS HH Episodes of Care	27.9	27.6	27.8	27.7

Average is based on capped expenditure measures.

Exhibit C-36. Total Number of Days in Baseline and Post-HHVBP Performance Periods for FFS-Claims Based Spending Measures, All HHVBP States and Non-HHVBP States

Measure	HHVBP States, Baseline (2013-2015)	Non-HHVBP States, Baseline (2013-2015)	HHVBP States, Post-HHVBP (2016-2019)	Non-HHVBP States, Post-HHVBP (2016-2019)
Average Medicare Spending per Day during and following FFS HH Episodes of Care	274,274,799	926,593,536	343,645,407	1,156,839,881
Average Medicare Spending per Day during FFS HH Episodes of Care	194,608,036	703,181,958	244,339,626	866,278,258
Average Medicare Spending per Day following FFS HH Episodes of Care	79,666,763	223,411,578	99,305,781	290,561,623

The number of days for each measure are derived from the corresponding D-in-D models

Exhibit C-37. Impact of the HHVBP Model between early years (2016-2017) vs. later years of HHVBP (2018-2019) for Claims-Based Spending Measures

Measure	D-in-D	p-value	Lower 90% CI	Upper 90% CI
Average Medicare Spending per Day during and following FFS HH Episodes of Care	-$0.26	0.70	-$1.36	$0.84
Average Medicare Spending per Day during FFS HH Episodes of Care	$0.86	0.24	-$0.34	$2.05
Average Medicare Spending per Day following FFS HH Episodes of Care	-$0.39	0.47	-$1.28	$0.50

C.7.1 Spending Components

Exhibit C-38. Baseline and Performance Period Means for Medicare Spending Components, All HHVBP States and Non-HHVBP States

Average Medicare spending per day by type of service	HHVBP States 2013-2015		Non-HHVBP States 2013-2015		HHVBP States 2016-2019		Non-HHVBP States 2016-2019	
	Mean	Percent	Mean	Percent	Mean	Percent	Mean	Percent
Average Medicare Spending per Day during and following FFS Home Health Episodes of Care								
Total	$138.33	100.0%	$131.61	100.0%	$148.72	100.0%	$144.26	100.0%
Home health	$44.87	31.8%	$41.07	30.5%	$45.42	29.9%	$43.36	29.4%
Inpatient	$45.60	32.8%	$46.70	35.2%	$50.12	33.6%	$50.83	35.1%
Outpatient institutional	$10.95	8.2%	$11.62	9.0%	$13.51	9.4%	$14.22	10.1%
ED and Observation Stays	$3.14	2.3%	$2.81	2.2%	$4.02	2.8%	$3.57	2.5%
Other	$7.72	5.9%	$8.73	6.9%	$9.37	6.6%	$10.54	7.6%
Skilled nursing facility	$11.36	8.1%	$9.93	7.4%	$11.67	7.7%	$10.83	7.4%
Hospice	$2.81	2.0%	$2.19	1.6%	$3.44	2.3%	$2.85	1.9%
Part B non-institutional*	$23.32	17.1%	$21.20	16.2%	$25.05	17.1%	$22.96	16.1%
Average Medicare Spending per Day during FFS Home Health Episodes of Care								
Total	$150.60	100.0%	$135.34	100.0%	$161.56	100.0%	$150.25	100.0%
Home health	$63.57	41.3%	$54.30	39.1%	$64.34	39.0%	$58.33	37.9%
Inpatient	$45.83	30.3%	$44.18	32.5%	$50.79	31.3%	$49.15	32.6%
Outpatient institutional	$11.23	7.8%	$11.79	8.9%	$13.97	9.0%	$14.55	9.9%
ED and Observation Stays	$3.43	2.3%	$2.98	2.2%	$4.43	2.8%	$3.85	2.6%
Other	$7.73	5.4%	$8.73	6.7%	$9.44	6.2%	$10.61	7.3%
Skilled nursing facility	$5.64	3.7%	$4.43	3.2%	$6.10	3.7%	$5.14	3.4%
Hospice	$1.62	1.1%	$1.11	0.8%	$1.90	1.2%	$1.42	0.9%
Part B non-institutional*	$23.53	15.9%	$20.68	15.4%	$25.17	15.9%	$22.53	15.2%
Average Medicare Spending per Day following FFS Home Health Episodes of Care								
Total	$105.97	100.0%	$116.54	100.0%	$114.80	100.0%	$123.35	100.0%
Inpatient	$45.05	41.1%	$54.49	44.8%	$48.47	40.9%	$55.73	43.5%
Outpatient institutional	$10.15	9.7%	$11.09	9.4%	$12.29	10.9%	$13.23	10.7%
ED and Observation Stays	$2.51	2.4%	$2.35	2.0%	$3.16	2.7%	$2.90	2.3%
Other	$7.59	7.4%	$8.69	7.5%	$9.06	8.1%	$10.26	8.4%
Skilled nursing facility	$25.25	22.8%	$27.16	22.2%	$25.14	21.0%	$27.42	21.3%
Hospice	$5.72	5.2%	$5.59	4.5%	$7.20	6.0%	$7.05	5.4%
Part B non-institutional*	$22.80	21.1%	$22.95	19.1%	$24.67	21.2%	$24.26	19.2%

**Includes Part B carrier and durable medical equipment claims.*
By definition, there is no home health spending associated with average Medicare spending per day following FFS home health episodes of care measure (see Exhibit A-41).
Average is based on capped expenditure measures. Capping was done separately for total and for each component such that component means do not add up to the total mean. Percent column is based on uncapped expenditure measure values.

Exhibit C-39. Cumulative D-in-D Results of the HHVBP Model on Medicare Spending Components

Medicare spending per day by type of service	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	% Relative Change
	D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Average Medicare Spending per Day during and following FFS Home Health Episodes of Care						
Total	-$1.76	0.01	-$2.89	-$0.63	$138.33	-1.3%
Home Health	$0.05	0.84	-$0.36	$0.46	$44.87	0.1%
Inpatient	-$1.11	0.01	-$1.85	-$0.36	$45.60	-2.4%
Outpatient Institutional	$0.07	0.55	-$0.12	$0.25	$10.95	0.6%
ED and Observation Stays	$0.19	<0.001	$0.12	$0.27	$3.14	6.1%
Other	-$0.14	0.15	-$0.29	$0.02	$7.72	-1.8%
Skilled nursing facility	-$0.48	<0.01	-$0.72	-$0.24	$11.36	-4.2%
Hospice	-$0.01	0.90	-$0.10	$0.09	$2.81	-0.4%
Part B non-institutional*	-$0.19	0.21	-$0.44	$0.06	$23.32	-0.8%
Average Medicare Spending per Day during FFS Home Health Episodes of Care						
Total	-$1.46	0.07	-$2.80	-$0.12	$150.60	-1.0%
Home Health	$0.60	0.15	-$0.09	$1.28	$63.57	0.9%
Inpatient	-$1.65	<0.001	-$2.44	-$0.86	$45.83	-3.6%
Outpatient Institutional	$0.06	0.64	-$0.15	$0.27	$11.23	0.5%
ED and Observation Stays	$0.23	<0.001	$0.14	$0.31	$3.43	6.7%
Other	-$0.17	0.12	-$0.35	$0.01	$7.73	-2.2%
Skilled nursing facility	-$0.28	<0.01	-$0.45	-$0.11	$5.64	-4.9%
Hospice	$0.03	0.47	-$0.04	$0.10	$1.62	1.9%
Part B non-institutional*	-$0.21	0.20	-$0.49	$0.06	$23.53	-0.9%
Average Medicare Spending per Day following FFS Home Health Episodes of Care						
Total	-$0.01	0.99	-$1.72	$1.70	$105.97	-0.01%
Inpatient	$0.81	0.29	-$0.46	$2.07	$45.05	1.8%
Outpatient Institutional	$0.09	0.49	-$0.13	$0.31	$10.15	0.9%
ED and Observation Stays	$0.13	0.02	$0.04	$0.21	$2.51	5.2%
Other	-$0.04	0.72	-$0.22	$0.14	$7.59	-0.5%
Skilled nursing facility	-$0.61	0.16	-$1.34	$0.11	$25.25	-2.4%
Hospice	-$0.16	0.23	-$0.39	$0.06	$5.72	-2.8%
Part B non-institutional*	$0.09	0.64	-$0.22	$0.39	$22.80	0.4%

**Includes Part B carrier and durable medical equipment claims.*
By definition, there is no home health spending associated with average Medicare spending per day following FFS home health episodes of care measure (see Exhibit A-41).
CI= Confidence Interval.| These models include state-specific linear time trends. | Average is based on capped expenditure measures. Capping was done separately for total and for each component such that the component means do not add up to the total mean.

Exhibit C-40. Impact of the HHVBP Model on Medicare Spending Components for Average Medicare Spending per Day during and following FFS HH Episodes of Care

Measure	Model Estimates				Average in HHVBP States, Baseline (2013-2015)	% Relative Change
	D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Home Health						
2016	$0.14	0.28	-$0.07	$0.35	$44.87	0.3%
2017	-$0.22	0.34	-$0.59	$0.16		-0.5%
2018	$0.10	0.74	-$0.41	$0.62		0.2%
2019	$0.19	0.63	-$0.46	$0.85		0.4%
Cumulative	$0.05	0.84	-$0.36	$0.46		0.1%
Inpatient						
2016	-$0.82	0.01	-$1.31	-$0.34	$45.60	-1.8%
2017	-$1.13	0.01	-$1.83	-$0.42		-2.5%
2018	-$1.10	0.05	-$2.01	-$0.20		-2.4%
2019	-$1.41	0.04	-$2.56	-$0.26		-3.1%
Cumulative	-$1.11	0.01	-$1.85	-$0.36		-2.4%
Outpatient Institutional						
2016	$0.15	0.03	$0.04	$0.27	$10.95	1.4%
2017	$0.13	0.24	-$0.05	$0.30		1.2%
2018	$0.02	0.89	-$0.21	$0.25		0.2%
2019	-$0.04	0.81	-$0.33	$0.24		-0.4%
Cumulative	$0.07	0.55	-$0.12	$0.25		0.6%
Outpatient ED and Observation Stays						
2016	$0.13	<0.001	$0.08	$0.17	$3.14	4.1%
2017	$0.19	<0.001	$0.12	$0.25		6.1%
2018	$0.22	<0.001	$0.13	$0.31		7.0%
2019	$0.26	<0.001	$0.15	$0.36		8.3%
Cumulative	$0.19	<0.001	$0.12	$0.27		6.1%
Other outpatient						
2016	$0.01	0.81	-$0.08	$0.11	$7.72	0.1%
2017	-$0.06	0.50	-$0.21	$0.09		-0.8%
2018	-$0.21	0.08	-$0.40	-$0.01		-2.7%
2019	-$0.31	0.03	-$0.55	-$0.08		-4.0%
Cumulative	-$0.14	0.15	-$0.29	$0.02		-1.8%
Skilled Nursing facility						
2016	-$0.31	0.001	-$0.46	-$0.15	$11.36	-2.7%
2017	-$0.48	0.001	-$0.71	-$0.25		-4.2%
2018	-$0.55	0.003	-$0.85	-$0.25		-4.8%
2019	-$0.59	0.01	-$0.95	-$0.22		-5.2%
Cumulative	-$0.48	0.001	-$0.72	-$0.24		-4.2%
Hospice						
2016	-$0.01	0.81	-$0.07	$0.05	$2.81	-0.4%
2017	-$0.04	0.42	-$0.14	$0.05		-1.4%
2018	-$0.07	0.33	-$0.18	$0.05		-2.5%
2019	$0.10	0.24	-$0.04	$0.25		3.6%
Cumulative	-$0.01	0.90	-$0.10	$0.09		-0.4%

Measure	Model Estimates				Average in HHVBP States, Baseline (2013-2015)	% Relative Change
	D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Part B non-institutional*						
2016	-$0.20	0.03	-$0.35	-$0.05	$23.32	-0.9%
2017	-$0.19	0.18	-$0.43	$0.05		-0.8%
2018	-$0.20	0.27	-$0.51	$0.10		-0.9%
2019	-$0.16	0.50	-$0.54	$0.22		-0.7%
Cumulative	-$0.19	0.21	-$0.44	$0.06		-0.8%

**Includes Part B carrier and durable medical equipment claims. CI= Confidence Interval.| These models include state-specific linear time trends. | Average is based on capped expenditure measures.*

C.8 Quality Measures Supporting Analyses

The below numbers reflect all OASIS home health episodes in the calendar year that were eligible for the specific OASIS outcome measure (regardless if their HHA received a TPS in 2019).

Exhibit C-41. "Start of Care" Values for Improvement in Pain Interfering in Activity in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	865,815	873,705	896,542	959,499	996,858	1,060,174	811,540
Non-HHVBP	2,667,264	2,777,138	2,935,002	3,148,509	3,335,924	3,519,368	2,694,558
Pain does not interfere with activity							
HHVBP	10.4%	9.8%	9.8%	8.7%	8.1%	8.0%	7.9%
Non-HHVBP	10.7%	10.1%	9.6%	8.9%	8.6%	8.3%	8.0%
Less often than daily							
HHVBP	11.7%	11.5%	11.9%	11.8%	12.3%	11.8%	11.5%
Non-HHVBP	13.3%	12.9%	12.7%	12.3%	12.5%	12.3%	12.0%
Daily, but not constant							
HHVBP	59.7%	59.7%	58.4%	57.6%	56.8%	56.4%	55.5%
Non-HHVBP	58.0%	58.2%	58.3%	57.8%	57.4%	57.3%	56.7%
Constant							
HHVBP	18.2%	19.0%	19.9%	21.9%	22.8%	23.7%	25.1%
Non-HHVBP	18.0%	18.8%	19.4%	20.9%	21.5%	22.1%	23.3%

Exhibit C-42. "Start of Care" Values for Improvement in Management of Oral Medications in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	771,673	800,339	852,276	953,709	1,035,315	1,119,852	1,154,937
Non-HHVBP	2,384,046	2,513,751	2,732,583	3,017,916	3,351,907	3,604,661	3,748,413
Patient is able to take oral medications if prepared in advance/another person develops a drug diary							
HHVBP	41.7%	39.6%	37.0%	31.6%	24.3%	18.8%	14.9%
Non-HHVBP	41.6%	39.8%	37.4%	33.8%	28.5%	23.4%	18.1%
Able to take medications at the correct time if given reminders by another person at the appropriate times							
HHVBP	20.3%	20.2%	19.5%	18.3%	16.6%	14.5%	12.7%
Non-HHVBP	22.0%	21.9%	21.5%	20.7%	19.5%	18.0%	16.1%
Unable to take medication unless administered by another person							
HHVBP	38.0%	40.3%	43.5%	50.1%	59.2%	66.6%	72.5%
Non-HHVBP	36.4%	38.3%	41.1%	45.5%	52.0%	58.6%	65.8%

Exhibit C-43. "Start of Care" Values for Improvement in Dyspnea in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	766,654	775,277	800,004	869,266	926,198	1,009,895	1,037,673
Non-HHVBP	2,308,751	2,381,205	2,528,073	2,741,505	2,939,729	3,178,796	3,314,104
Patient is short of breath only when walking more than 20 feet							
HHVBP	38.4%	37.7%	37.6%	35.8%	33.1%	30.3%	29.1%
Non-HHVBP	37.1%	36.8%	36.6%	35.3%	33.5%	31.5%	30.2%
With moderate exertion							
HHVBP	43.4%	43.9%	43.5%	43.5%	45.3%	47.0%	46.8%
Non-HHVBP	42.9%	43.1%	42.8%	43.1%	44.5%	46.0%	45.9%
With minimal exertion or at rest							
HHVBP	18.2%	18.4%	18.9%	20.7%	21.7%	22.7%	24.1%
Non-HHVBP	20.0%	20.0%	20.6%	21.6%	22.0%	22.5%	23.9%

Exhibit C-44. "Start of Care" Values for Improvement in Status of Surgical Wounds in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	159,863	152,718	147,646	146,786	143,232	141,713	102,206
Non-HHVBP	542,872	534,254	524,482	522,783	515,462	501,565	364,408
Fully granulating							
HHVBP	10.1%	8.7%	7.9%	7.0%	6.7%	6.5%	6.5%
Non-HHVBP	10.1%	8.8%	8.2%	7.7%	7.4%	7.1%	7.3%
Early/partial granulation							
HHVBP	25.3%	20.9%	18.1%	15.7%	14.4%	13.7%	14.0%
Non-HHVBP	24.2%	20.4%	18.4%	16.9%	15.6%	14.8%	15.3%
Not healing							
HHVBP	64.6%	70.4%	74.0%	77.3%	78.9%	79.8%	79.6%
Non-HHVBP	65.7%	70.7%	73.4%	75.4%	77.1%	78.1%	77.4%

Exhibit C-45. "Start of Care" Values for Total Normalized Composite (TNC) Change in Self-Care in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	1,492,982	1,491,034	1,523,416	1,564,658	1,603,821	1,673,529	1,691,961
Non-HHVBP	4,772,081	4,860,279	5,048,093	5,239,078	5,446,677	5,605,606	5,674,411
Average SOC values							
HHVBP	9.3	9.7	10.1	10.7	11.2	11.5	11.6
Non-HHVBP	9.3	9.6	9.9	10.4	10.9	11.2	11.3

Exhibit C-46. "Start of Care" Values for Total Normalized Composite (TNC) Change in Mobility in 2013 – 2019, HHVBP States and Non-HHVBP States

	2013	2014	2015	2016	2017	2018	2019
Sample Size							
HHVBP	1,492,982	1,491,034	1,523,416	1,564,658	1,603,821	1,673,529	1,691,961
Non-HHVBP	4,772,081	4,860,279	5,048,093	5,239,078	5,446,677	5,605,606	5,674,411
Average SOC values							
HHVBP	4.7	5.0	5.2	5.7	6.1	6.3	6.4
Non-HHVBP	4.8	5.0	5.2	5.6	5.9	6.2	6.3

Exhibit C-47. Impact of the HHVBP Model between early years (2016 – 2017) vs. later years of HHVBP (2018 – 2019) for OASIS-Based Measures and Mortality Rate among FFS Beneficiaries

Measure	D-in-D[a]	p-value	Lower 90% CI[a]	Upper 90% CI[a]
Discharged to Community	0.58	0.01	0.21	0.96
TNC Change in Self-Care	0.02	0.14	-0.002	0.04
TNC Change in Mobility	0.005	0.32	-0.003	0.01
Improvement in Dyspnea	-0.91	0.11	-1.85	0.03
Improvement in Management of Oral Medications	0.42	0.54	-0.71	1.55
Improvement in Pain Interfering with Activity	0.70	0.14	-0.07	1.47
Improvement in Status of Surgical Wounds	0.37	0.34	-0.27	1.02
Mortality Rate/All FFS Home Health Episodes	0.04	0.13	-0.003	0.07

[a] *Values represent percentage point changes with the exception of the TNC measures. | HHVBP Measures indicated by italic text. | CI= Confidence Interval.| These models (with the exception of Mortality rate measure) include state-specific linear time trends (See Section A.1.5 for more details).*

Exhibit C-48. Share of OASIS SOC Assessments with Lower Functional Status for All FFS Beneficiaries Receiving Home Health Care, HHVBP States and Non-HHVBP States, by Measure

Measure	HHVBP States			Non-HHVBP States		
	Baseline	Post-HHVBP		Baseline	Post-HHVBP	
	2013-2015	2016-2017	2018-2019	2013-2015	2016-2017	2018-2019
Ambulation	57.0%	76.3%	84.3%	53.3%	68.3%	76.7%
Dyspnea	49.5%	56.0%	63.0%	54.9%	58.9%	64.4%
Grooming	42.2%	55.0%	61.1%	42.8%	52.3%	58.4%

Includes all FFS beneficiaries with a home health episode, regardless of diagnosis or prior inpatient stay.

Exhibit C-49. Baseline and Post-HHVBP Performance Period Means for Patient Mortality among FFS Beneficiaries, All HHVBP States and Non-HHVBP States

Measure	HHVBP States, Baseline (2013-2015)	Non-HHVBP States, Baseline (2013-2015)	HHVBP States, Post-HHVBP (2016-2019)	Non-HHVBP States, Post-HHVBP (2016-2019)
Mortality Rate/All FFS Home Health Episodes, Unadjusted	3.5%	3.3%	3.6%	3.3%
Mortality Rate/All FFS Home Health Episodes, Adjusted	3.4%	3.5%	3.1%	3.3%

Exhibit C-50. Trends in Unadjusted Mortality Rate among Medicare FFS HH Beneficiaries by HHVBP and non-HHVBP states, 2013 – 2019

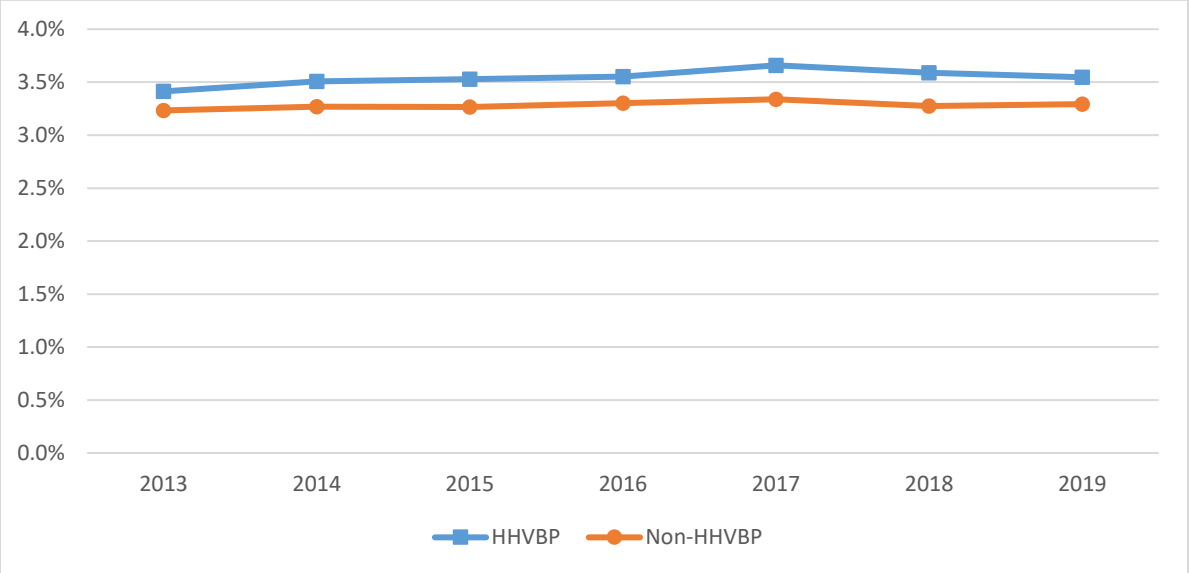
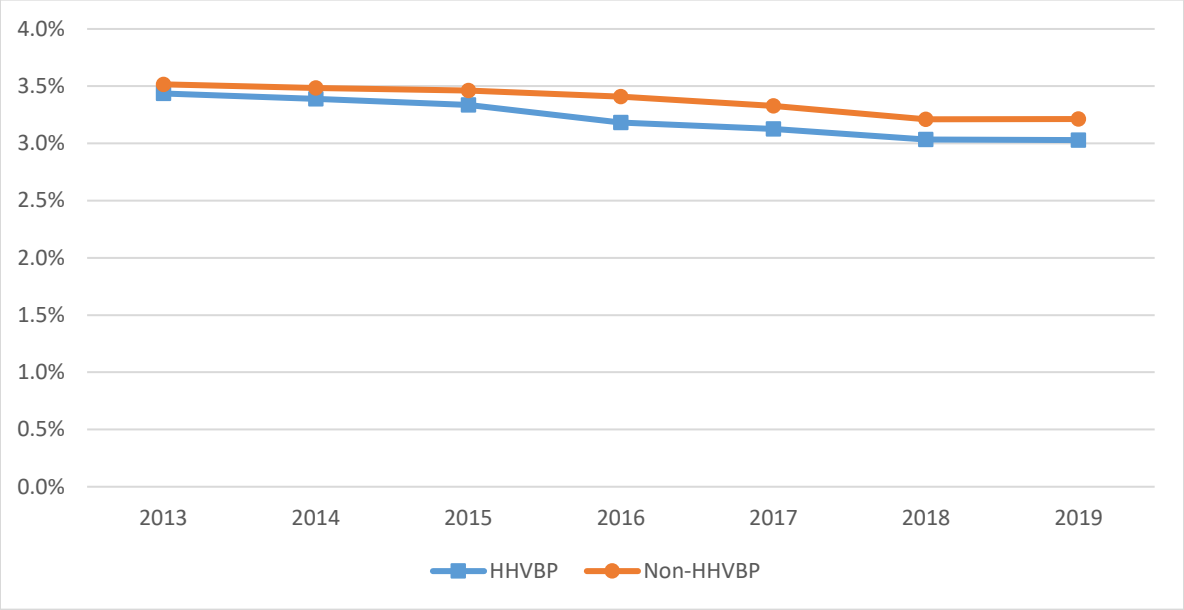


Exhibit C-51. Trends in Risk-Adjusted Mortality Rate among Medicare FFS HH Beneficiaries by HHVBP and non-HHVBP states, 2013 – 2019



C.9 Patient Experience with Care Supporting Analyses

Exhibit C-52. Impact of the HHVBP Model between early years (2016 – 2017) vs. later years of HHVBP (2018 – 2019) for HHCAHPS-Based Measures

Measure	D-in-D[a]	p-value	Lower 90% CI[a]	Upper 90% CI[a]
How often the home health team gave care in a professional way (Professional Care)	-0.19	0.14	-0.41	0.02
How well did the home health team communicate with patients (Communication)	-0.22	0.15	-0.46	0.03
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)	-0.37	0.03	-0.65	-0.08
How do patients rate the overall care from the home health agency (Overall Care)	0.07	0.74	-0.27	0.41
Would patients recommend the home health agency to friends and family (Likely to Recommend)	0.03	0.89	-0.36	0.43

[a] *Values represent percentage point changes. | HHVBP Measures indicated by italic text. | CI= Confidence Interval.*

C.10 Vulnerable Populations Supporting Analyses

Exhibit C-53. Characteristics of OASIS Episodes by Medicaid and HHVBP Status, 2013 – 2019

	HHVBP				Non-HHVBP			
	Baseline (2013-2015)		Post Period (2016-2019)		Baseline (2013-2015)		Post Period (2016-2019)	
	Medicaid	Non-Medicaid	Medicaid	Non-Medicaid	Medicaid	Non-Medicaid	Medicaid	Non-Medicaid
N OASIS episodes	1,429,249	3,083,548	1,856,056	4,688,579	4,892,193	9,806,133	7,000,676	15,025,350
Average age (years)	68.06	78.89	68.12	78.93	67.03	78.11	67.27	78.18
Female	65.5%	59.5%	64.8%	58.8%	65.7%	59.5%	64.6%	58.9%
Race/Ethnicity (mutually exclusive)								
Hispanic	22.3%	2.7%	17.5%	3.2%	14.4%	3.6%	13.9%	4.0%
Non-Hispanic Black	18.4%	7.0%	19.8%	7.8%	25.5%	9.6%	24.5%	9.5%
Non-Hispanic White	56.7%	89.2%	59.5%	87.7%	54.3%	84.9%	55.7%	84.4%
Non-Hispanic Other Race	2.4%	0.9%	3.0%	1.1%	5.5%	1.7%	5.8%	2.0%
Non-Hispanic Multiracial	0.2%	0.1%	0.2%	0.1%	0.2%	0.2%	0.2%	0.2%
Average HCC Score (1st episode)	2.91	2.63	3.35	2.88	2.95	2.66	3.19	2.89
ESRD flag	5.2%	2.4%	6.7%	2.6%	6.9%	2.9%	7.4%	3.1%
Discharge from Inpatient within 14 days	61.6%	70.7%	66.6%	70.0%	67.1%	73.6%	67.4%	73.0%
Rural	5.2%	3.7%	5.2%	3.6%	8.1%	6.8%	7.8%	6.7%
HHA Ownership								
For-profit	68.3%	62.9%	67.7%	65.7%	61.8%	55.1%	63.2%	59.3%
Non-profit	28.0%	33.4%	29.4%	31.6%	35.1%	42.3%	34.4%	38.8%
Government-owned	3.7%	3.6%	2.9%	2.7%	3.1%	2.6%	2.4%	2.0%
HHA Chain Affiliation								
Chain Affiliated	38.3%	51.0%	44.7%	54.2%	30.4%	38.6%	34.0%	42.4%
No Chain Affiliation	49.8%	40.4%	47.6%	38.0%	59.6%	50.0%	57.6%	48.1%
Chain Affiliation Unknown/Missing	11.8%	8.6%	7.7%	7.8%	9.9%	11.3%	8.3%	9.5%

Exhibit C-54. Characteristics of OASIS Home Health Episodes by Rural/Urban Location and HHVBP Status, 2013 – 2019

	HHVBP				Non-HHVBP			
	Baseline (2013-2015)		Post Period (2016-2019)		Baseline (2013-2015)		Post Period (2016-2019)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
HH episodes (N)	188,021	4,323,257	265,410	6,278,073	1,061,925	13,629,851	1,543,233	20,473,897
Average age (years)	73.83	75.53	74.15	75.94	73.52	74.50	73.69	74.78
Female	61.4%	61.4%	60.3%	60.5%	60.2%	61.7%	59.3%	60.8%
Race/Ethnicity (mutually exclusive)								
Hispanic	0.5%	9.3%	0.6%	7.6%	2.1%	7.6%	2.1%	7.5%
Non-Hispanic Black	10.2%	10.6%	10.8%	11.3%	10.4%	15.3%	10.3%	14.5%
Non-Hispanic White	88.5%	78.5%	87.8%	79.3%	86.1%	73.9%	86.3%	74.4%
Non-Hispanic Other Race	0.6%	1.4%	0.7%	1.7%	1.2%	3.1%	1.2%	3.4%
Non-Hispanic Multiracial	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%
Average HCC Score (1st episode)	2.69	2.71	2.97	2.99	2.59	2.76	2.86	2.99
ESRD flag	3.0%	3.3%	3.2%	3.6%	3.0%	4.3%	3.3%	4.5%
Discharge from inpatient facility within 14 days	34.3%	27.3%	31.5%	23.8%	31.2%	27.1%	29.5%	25.5%
Dual Eligible	72.9%	67.6%	71.1%	69.0%	73.1%	71.3%	72.2%	71.1%
HHA Ownership								
For-profit	55.0%	65.1%	62.0%	66.5%	55.1%	57.5%	60.5%	60.5%
Non-profit	26.1%	31.9%	25.7%	31.2%	35.2%	40.3%	32.5%	37.8%
Government-owned	18.9%	3.0%	12.4%	2.3%	9.7%	2.2%	7.0%	1.7%
HHA Chain Affiliation								
Chain Affiliated	50.4%	46.8%	54.7%	51.4%	44.3%	35.3%	49.6%	39.0%
No Chain Affiliation	43.0%	43.4%	39.1%	40.8%	46.4%	53.8%	42.8%	51.8%
Chain Affiliation Unknown/Missing	6.5%	9.7%	6.2%	7.8%	9.3%	11.0%	7.6%	9.2%
HHA Age								
<4 years	2.3%	6.3%	0.9%	2.6%	1.7%	5.0%	1.1%	3.0%
4-10 years	8.1%	23.6%	8.4%	17.6%	9.9%	18.1%	6.4%	14.6%
>10 years	89.6%	70.1%	90.7%	79.9%	88.3%	76.9%	92.5%	82.4%
HHA Size								
1-59 OASIS Episodes	2.0%	0.7%	1.4%	0.5%	1.4%	1.3%	1.0%	1.0%
60-249 OASIS Episodes	14.2%	5.6%	12.1%	3.8%	13.9%	8.8%	10.1%	6.7%
250-499 OASIS Episodes	15.6%	9.7%	14.1%	7.0%	18.2%	10.9%	15.0%	8.8%

	HHVBP				Non-HHVBP			
	Baseline (2013-2015)		Post Period (2016-2019)		Baseline (2013-2015)		Post Period (2016-2019)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
500-999 OASIS Episodes	21.7%	16.2%	16.1%	13.0%	22.8%	14.9%	22.0%	13.6%
1000+ OASIS Episodes	46.4%	67.9%	56.3%	75.7%	43.8%	64.1%	51.9%	70.0%

Exhibit C-55. Differences in Covariate Adjusted Utilization and Spending Measures among Home Health Medicare FFS Beneficiaries without Adjustment for HCC Risk Score by Dual Eligibility, 2013 – 2015

Measure	Subgroup Comparison	Difference Estimate	P-value
Unplanned Acute Care Hospitalization/First FFS HH Episodes	Dual vs. Non-Dual	0.83	<0.001
ED Use (No Hospitalization)/First FFS HH Episodes	Dual vs. Non-Dual	2.24	<0.001
Medicare Spending per Day during and following FFS HH Episodes of Care	Dual vs. Non-Dual	-$0.27	0.14

Exhibit C-56. Differences in Covariate Adjusted TNC Measures with HCC Risk Score by Medicaid Status or Rural/Urban Location, 2013 – 2015

Measure	Subgroup Comparison	Difference Estimate	P-value
Total Normalized Composite (TNC) Change in Self-Care	Medicaid vs. Non-Medicaid	-0.08	<0.01
	Rural vs. Urban	0.02	0.01
Total Normalized Composite (TNC) Change in Mobility	Medicaid vs. Non-Medicaid	-0.02	<0.01
	Rural vs. Urban	0.006	0.03

Exhibit C-57. Differential Impact of HHVBP Model on Covariate Adjusted TNC Measures with HCC Risk Score by Medicaid Status or Rural/Urban Location, 2013 – 2019

Measure	Medicaid		Non-Medicaid		Medicaid – Non-Medicaid	
	D-in-D	P-value	D-in-D	P-value	D-in-D-in-D	P-value
Total Normalized Composite (TNC) Change in Self-Care	0.0006	0.97	0.05	<0.01	-0.05	<0.01
Total Normalized Composite (TNC) Change in Mobility	0.004	0.44	0.02	<0.01	-0.01	<0.01

	Rural		Urban		Rural - Urban	
	D-in-D	P-value	D-in-D	P-value	D-in-D-in-D	P-value
Total Normalized Composite (TNC) Change in Self-Care	0.05	0.03	0.04	<0.01	0.004	0.82
Total Normalized Composite (TNC) Change in Mobility	0.02	0.01	0.02	<0.01	0.004	0.55

C.11 Sample Size Tables

The exhibits in this section provide the sample size for their corresponding table in the Fourth Annual Report. For example, Exhibit 13n corresponds to Exhibit 13 in the Fourth Annual Report.

Exhibit 13n. Sample Size for Cumulative D-in-D Results for Home Health Utilization among FFS Beneficiaries

Measure	HHVBP	Non-HHVBP
Percent of FFS Beneficiaries with at Least One HH Episode	3,822	18,138
Number of HH Episodes per 1,000 FFS Beneficiaries	3,822	18,138

These numbers represent the number of county-years. | Sample size reflects episodes from 2013-2019 with non-missing data.

Exhibit 24n. Sample Size for Cumulative D-in-D Results for Case-Mix of Home Health Patients

Measure	HHVBP	Non-HHVBP
HCC Score at the Start of Care	10,030,804	34,781,560
TNC Mobility at the Start of Care	11,039,791	36,635,793
TNC Self Care at the Start of Care	11,039,791	36,635,793

Sample size reflects episodes from 2013 – 2019 with non-missing data.

Exhibit 27n. Sample Size for Cumulative D-in-D Results for Post-Acute Care FFS Medicare Beneficiaries

Measure	HHVBP	Non-HHVBP
Home Health Care	13,088,165	41,785,141
Skilled Nursing Facility	13,088,165	41,785,141
Inpatient Rehabilitation Facility	13,088,165	41,785,141
Self-Care	13,088,165	41,785,141
Hospital Outpatient Therapy	13,088,165	41,785,141

Sample size reflects hospital discharges from 2013 – 2019 with non-missing data.

Exhibit 33n. Sample Size for Cumulative D-in-D Results for Frontloading Analyses

Measure	HHVBP	Non-HHVBP
Number of Skilled Nursing Visits During First 2 Weeks	1,514,728	4,767,446
Number of Therapy Visits During First 2 Weeks	1,514,728	4,767,446
Frontloading Skilled Nursing Visits	1,514,728	4,767,446
Frontloading Therapy Visits	1,514,728	4,767,446

Counts displayed above represent a subset of claims-based episodes, only including post-institutional episodes which lasted at least 14 days without a hospitalization occurring during that time.

Exhibit 45n. Sample Size for Cumulative D-in-D Results for FFS Claims-Based Utilization Measures

FFS Claims-Based Health Care Utilization Measures	HHVBP	Non-HHVBP
Unplanned Acute Care Hospitalization/First FFS HH Episodes	4,688,694	13,442,635
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes	4,688,694	13,442,635
ED Use followed by Inpatient Admission/First FFS HH Episodes	4,731,224	13,571,321

FFS Claims-Based Health Care Utilization Measures	HHVBP	Non-HHVBP
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes	4,731,224	13,571,321
Unplanned Acute Care Hospitalization/All FFS HH Episodes	8,097,085	27,536,910
SNF Use/All FFS HH Episodes	8,097,085	27,536,910

HHVBP Measures indicated by italic text. | Sample size reflects episodes from 2013 – 2019 with non-missing data.

Exhibit 56n. Sample Size for Cumulative D-in-D Results for FFS Claims-Based Spending Measures

FFS Claims-Based Spending Measures	HHVBP	Non-HHVBP
Average Medicare Spending per Day during and following FFS HH Episodes of Care	9,494,504	32,127,847
Average Medicare Spending per Day during FFS HH Episodes of Care	9,494,504	32,127,847
Average Medicare Spending per Day following FFS HH Episodes of Care	6,438,282	18,583,687

Sample size reflects episodes from 2013 – 2019 with non-missing data.

Exhibit 63n. Sample Size for Cumulative D-in-D Results for OASIS Outcome and Mortality Measures

OASIS-Based Outcome Impact Measures	HHVBP	Non-HHVBP
Discharged to Community	10,856,116	36,026,966
Total Normalized Composite (TNC) Change in Self-Care	8,090,170	26,205,273
Total Normalized Composite (TNC) Change in Mobility	8,090,170	26,205,273
Improvement in Dyspnea	6,184,967	19,392,163
Improvement in Management of Oral Medications	6,688,101	21,353,277
Improvement in Pain Interfering with Activity	6,734,988	21,976,865
Improvement in Status of Surgical Wounds	994,164	3,505,826
60 Day Mortality/All FFS Episodes	9,299,574	31,389,700

HHVBP Measures indicated by italic text. | Sample size reflects episodes from 2013 – 2019 with non-missing data.

Exhibit 71n. Sample Size for Cumulative D-in-D Results for HHCAHPS-Based Impact Measures

HHCAHPS-Based Patient Experience Impact Measures	HHVBP	Non-HHVBP
All 5 HHCAHPS-Based Patient Experience Impact Measures	10,569	43,830

HHVBP Measures indicated by italic text. | Sample size reflects episodes from 2013 – 2019 with non-missing data.

C.12 State-Level D-in-D Analyses

Exhibit C-58. Cumulative D-in-D Results at the State-Level, Case Mix of Home Health Patients

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	% Relative Change
	D-in-D	P-value	Lower 90% CI	Upper 90% CI		
HCC Score at the Start of Care						
Arizona	-0.09	0.07	-0.18	-0.01	2.9	-3.1%
Florida	-0.05	0.02	-0.08	-0.01	2.6	-1.9%
Iowa	-0.01	0.76	-0.09	0.06	2.6	-0.4%
Maryland	0.01	0.76	-0.05	0.07	2.9	0.3%
Massachusetts	-0.05	0.11	-0.09	0.001	2.7	-1.9%
Nebraska	-0.01	0.84	-0.09	0.07	2.6	-0.4%
North Carolina	-0.01	0.73	-0.06	0.04	2.8	-0.4%
Tennessee	-0.09	<0.01	-0.15	-0.04	2.7	-3.3%
Washington	-0.03	0.58	-0.11	0.05	2.8	-1.1%
TNC Mobility at Start of Care						
Arizona	0.34	0.01	0.11	0.57	5.0	6.8%
Florida	-0.09	0.21	-0.21	0.03	5.0	-1.8%
Iowa	0.16	0.39	-0.15	0.47	4.4	3.6%
Maryland	0.41	<0.001	0.21	0.62	5.1	8.0%
Massachusetts	0.001	0.99	-0.36	0.37	4.5	0.02%
Nebraska	-0.20	0.31	-0.53	0.12	4.5	-4.4%
North Carolina	0.20	0.09	0.005	0.40	4.9	4.1%
Tennessee	-0.53	<0.001	-0.75	-0.30	5.7	-9.3%
Washington	-0.14	0.45	-0.45	0.17	5.4	-2.6%
TNC Self-Care at Start of Care						
Arizona	0.49	0.05	0.07	0.91	9.0	5.4%
Florida	-0.08	0.52	-0.28	0.12	9.9	-0.8%
Iowa	0.24	0.51	-0.36	0.85	8.3	2.9%
Maryland	0.65	0.01	0.25	1.05	10.0	6.5%
Massachusetts	-0.18	0.69	-0.89	0.54	9.0	-2.0%
Nebraska	-0.36	0.47	-1.20	0.47	8.4	-4.3%
North Carolina	0.32	0.13	-0.03	0.67	9.5	3.4%
Tennessee	-0.63	<0.01	-0.98	-0.28	10.9	-5.8%
Washington	-0.25	0.47	-0.82	0.32	9.9	-2.5%

CI = Confidence Interval. | These models include state-specific linear time trends.

Exhibit C-59. Cumulative D-in-D Results at the State-Level, Home Health Utilization Measures

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	% Relative Change
	D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Percent of FFS Beneficiaries with at least One HH Episode[a]						
Arizona	-0.11	0.67	-0.54	0.32	6.8%	-1.6%
Florida	0.24	0.58	-0.46	0.93	14.8%	1.6%
Iowa	0.83	<0.001	0.48	1.19	5.6%	14.8%
Maryland	-0.003	0.99	-0.29	0.29	8.8%	0.03%
Massachusetts	-0.36	0.84	-3.27	2.55	12.5%	-2.9%
Nebraska	0.13	0.55	-0.23	0.50	6.0%	2.2%
North Carolina	-0.47	<0.01	-0.75	-0.20	8.7%	-5.4%
Tennessee	0.60	<0.01	0.28	0.93	9.7%	6.2%
Washington	0.11	0.53	-0.19	0.41	5.7%	2.0%
Number of HH Episodes per 1,000 FFS Beneficiaries						
Arizona	0.22	0.96	-7.74	8.18	100.4	0.2%
Florida	9.65	0.61	-21.37	40.67	276.5	3.5%
Iowa	16.46	<0.001	10.05	22.87	82.0	20.1%
Maryland	1.43	0.62	-3.37	6.24	126.2	1.1%
Massachusetts	1.01	0.97	-48.51	50.53	206.5	0.5%
Nebraska	2.30	0.61	-5.15	9.74	92.2	2.5%
North Carolina	-9.44	<0.01	-14.07	-4.81	134.9	-7.0%
Tennessee	28.69	<0.001	17.81	39.57	201.7	14.2%
Washington	5.41	0.14	-0.61	11.43	85.6	6.3%

[a]D-in-D and 90% CI values represent percentage point changes. |CI = Confidence Interval. | These models include state-specific linear time trends.

Exhibit C-60. Cumulative D-in-D Results at the State-Level, Utilization Measures

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
Unplanned Acute Care Hospitalization/First FFS HH Episodes						
Arizona	-0.07	0.91	-1.07	0.93	15.8%	-0.4%
Florida	-0.51	0.04	-0.93	-0.09	14.0%	-3.6%
Iowa	0.002	1.00	-1.18	1.18	17.3%	0.01%
Maryland	0.31	0.45	-0.36	0.97	18.4%	1.7%
Massachusetts	-0.72	0.20	-1.66	0.21	16.9%	-4.3%
Nebraska	-0.77	0.33	-2.06	0.52	16.9%	-4.6%
North Carolina	0.40	0.35	-0.30	1.09	16.7%	2.4%
Tennessee	-0.85	0.10	-1.70	-0.004	17.5%	-4.9%
Washington	1.44	0.05	0.23	2.65	15.4%	9.4%
Outpatient ED Use (no Hospitalization)/First FFS HH Episodes						
Arizona	-0.27	0.65	-1.26	0.71	13.1%	-2.1%
Florida	0.58	0.01	0.21	0.96	9.9%	5.9%
Iowa	0.92	0.25	-0.38	2.21	14.0%	6.6%

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
Maryland	0.27	0.60	-0.57	1.11	12.0%	2.3%
Massachusetts	-0.03	0.95	-0.82	0.76	12.5%	-0.2%
Nebraska	0.78	0.25	-0.33	1.88	11.7%	6.7%
North Carolina	-0.11	0.78	-0.76	0.54	14.3%	-0.8%
Tennessee	-0.42	0.28	-1.04	0.21	13.0%	-3.2%
Washington	-0.80	0.35	-2.22	0.62	14.4%	-5.6%
ED Use followed by Inpatient Admission/First FFS HH Episodes						
Arizona	0.06	0.91	-0.86	0.97	14.2%	0.4%
Florida	-0.89	<0.001	-1.30	-0.49	13.2%	-6.7%
Iowa	-0.35	0.60	-1.44	0.74	12.1%	-2.9%
Maryland	0.11	0.78	-0.52	0.73	17.5%	0.6%
Massachusetts	-0.87	0.11	-1.79	0.04	15.5%	-5.6%
Nebraska	-0.43	0.62	-1.85	0.98	11.9%	-3.6%
North Carolina	0.44	0.28	-0.23	1.11	14.6%	3.0%
Tennessee	-0.37	0.44	-1.17	0.43	15.3%	-2.4%
Washington	1.42	0.05	0.22	2.63	13.1%	10.8%
Total ED Use (Outpatient or Inpatient Claims)/First FFS HH Episodes						
Arizona	-0.32	0.70	-1.66	1.02	28.2%	-1.1%
Florida	-0.04	0.90	-0.57	0.49	23.3%	-0.2%
Iowa	0.81	0.41	-0.82	2.44	29.5%	2.7%
Maryland	0.50	0.45	-0.59	1.60	29.8%	1.7%
Massachusetts	-0.63	0.36	-1.77	0.50	28.4%	-2.2%
Nebraska	-0.31	0.77	-2.07	1.45	26.3%	-1.2%
North Carolina	0.34	0.53	-0.57	1.26	30.1%	1.1%
Tennessee	-0.94	0.12	-1.93	0.06	29.4%	-3.2%
Washington	0.83	0.37	-0.68	2.34	29.2%	2.8%
Unplanned Acute Care Hospitalization/All FFS HH Episodes						
Arizona	-0.39	0.50	-1.33	0.56	16.9%	-2.3%
Florida	-0.98	<0.001	-1.32	-0.64	15.6%	-6.3%
Iowa	-0.79	0.20	-1.80	0.22	18.3%	-4.3%
Maryland	0.07	0.89	-0.72	0.85	20.2%	0.3%
Massachusetts	-0.49	0.33	-1.33	0.35	19.1%	-2.6%
Nebraska	-0.96	0.22	-2.27	0.34	17.3%	-5.5%
North Carolina	0.34	0.35	-0.26	0.95	18.2%	1.9%
Tennessee	-0.77	0.05	-1.43	-0.12	17.2%	-4.5%
Washington	0.98	0.13	-0.08	2.04	16.0%	6.1%
SNF Use/All FFS HH Episodes						
Arizona	-0.23	0.50	-0.78	0.32	4.4%	-5.2%
Florida	-0.03	0.73	-0.19	0.12	4.1%	-0.7%
Iowa	-1.31	<0.01	-1.99	-0.63	6.6%	-19.8%
Maryland	-0.15	0.54	-0.54	0.25	6.0%	-2.5%
Massachusetts	-0.51	0.11	-1.02	0.01	6.9%	-7.4%
Nebraska	-0.68	0.13	-1.43	0.06	6.7%	-10.1%

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
North Carolina	0.19	0.34	-0.14	0.51	4.6%	4.1%
Tennessee	-0.61	<0.01	-0.96	-0.26	5.0%	-12.2%
Washington	0.08	0.86	-0.65	0.81	4.9%	1.6%

[a]*Values represent percentage point changes. | HHVBP Measures indicated by italic text. | CI = Confidence Interval. | These models include state-specific linear time trends.*

Exhibit C-61. Cumulative D-in-D Results at the State-Level, Spending Measures

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D	P-value	Lower 90% CI	Upper 90% CI		
Average Medicare Spending per Day during and following FFS HH Episodes of Care						
Arizona	-$3.06	0.28	-$7.77	$1.65	$151.53	-2.0%
Florida	-$1.74	0.103	-$3.50	$0.01	$133.25	-1.3%
Iowa	-$7.95	0.02	-$13.34	-$2.57	$132.69	-6.0%
Maryland	$8.07	<0.01	$4.03	$12.11	$172.20	4.7%
Massachusetts	-$6.02	0.02	-$10.42	-$1.62	$156.91	-3.8%
Nebraska	-$7.90	0.04	-$14.32	-$1.47	$136.46	-5.8%
North Carolina	$0.57	0.71	-$1.96	$3.10	$130.58	0.4%
Tennessee	-$4.62	<0.01	-$7.29	-$1.95	$121.90	-3.8%
Washington	$2.17	0.51	-$3.25	$7.60	$140.88	1.5%
Average Medicare Spending per Day during FFS HH Episodes of Care						
Arizona	-$3.85	0.34	-$10.51	$2.81	$170.20	-2.3%
Florida	$0.26	0.84	-$1.83	$2.35	$145.88	0.2%
Iowa	-$12.57	<0.01	-$18.83	-$6.31	$149.77	-8.4%
Maryland	$5.38	0.11	-$0.13	$10.90	$192.62	2.8%
Massachusetts	-$6.30	0.02	-$10.80	-$1.80	$173.38	-3.6%
Nebraska	-$7.82	0.06	-$14.65	-$0.98	$150.41	-5.2%
North Carolina	$2.31	0.24	-$0.93	$5.54	$143.49	1.6%
Tennessee	-$6.45	<0.01	-$9.88	-$3.03	$123.40	-5.2%
Washington	$0.57	0.87	-$5.27	$6.41	$156.53	0.4%
Average Medicare Spending per Day following FFS HH Episodes of Care						
Arizona	$1.65	0.65	-$4.29	$7.60	$112.25	1.5%
Florida	$2.71	0.18	-$0.65	$6.07	$99.58	2.7%
Iowa	-$2.56	0.56	-$9.78	$4.65	$95.27	-2.7%
Maryland	$11.36	<0.001	$6.40	$16.32	$129.10	8.8%
Massachusetts	-$5.24	0.17	-$11.52	$1.05	$116.34	-4.5%
Nebraska	-$5.08	0.42	-$15.53	$5.38	$104.13	-4.9%
North Carolina	-$1.11	0.59	-$4.51	$2.30	$99.37	-1.1%
Tennessee	-$1.27	0.64	-$5.77	$3.23	$113.91	-1.1%
Washington	$1.69	0.73	-$6.35	$9.73	$103.62	1.6%

CI= Confidence Interval. | These models include state-specific linear time trends.

Exhibit C-62. Cumulative D-in-D Results of the HHVBP Model on Medicare Spending Components

	Medicare spending per day by type of service	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
		D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Average Medicare Spending per Day during and following FFS Home Health Episodes of Care							
Arizona	Total	-$3.06	0.28	-$7.77	$1.65	$151.53	-2.0%
	Inpatient	-$2.56	0.17	-$5.64	$0.52	$54.50	-4.7%
	Skilled nursing facility	-$0.15	0.83	-$1.30	$1.00	$10.04	-1.5%
Florida	Total	-$1.74	0.10	-$3.50	$0.01	$133.25	-1.3%
	Inpatient	-$1.01	0.14	-$2.14	$0.12	$38.61	-2.6%
	Skilled nursing facility	-$0.26	0.22	-$0.61	$0.09	$10.00	-2.6%
Iowa	Total	-$7.95	0.02	-$13.34	-$2.57	$132.69	-6.0%
	Inpatient	-$3.44	0.22	-$8.03	$1.15	$43.80	-7.9%
	Skilled nursing facility	-$3.23	<0.001	-$4.65	-$1.81	$14.29	-22.6%
Maryland	Total	$8.07	0.001	$4.03	$12.11	$172.20	4.7%
	Inpatient	$5.59	0.004	$2.45	$8.73	$72.11	7.8%
	Skilled nursing facility	$0.60	0.25	-$0.26	$1.46	$13.47	4.5%
Massachusetts	Total	-$6.02	0.02	-$10.42	-$1.62	$156.91	-3.8%
	Inpatient	-$4.12	0.02	-$7.08	-$1.17	$60.17	-6.8%
	Skilled nursing facility	-$0.49	0.40	-$1.44	$0.46	$15.33	-3.2%
Nebraska	Total	-$7.90	0.04	-$14.32	-$1.47	$136.46	-5.8%
	Inpatient	-$3.39	0.19	-$7.60	$0.82	$43.13	-7.9%
	Skilled nursing facility	-$1.87	0.08	-$3.64	-$0.11	$15.66	-11.9%
North Carolina	Total	$0.57	0.71	-$1.96	$3.10	$130.58	0.4%
	Inpatient	-$0.12	0.91	-$1.92	$1.68	$45.69	-0.3%
	Skilled nursing facility	$0.19	0.58	-$0.36	$0.74	$9.68	2.0%
Tennessee	Total	-$4.62	0.004	-$7.29	-$1.95	$121.90	-3.8%
	Inpatient	-$1.93	0.07	-$3.67	-$0.19	$39.65	-4.9%
	Skilled nursing facility	-$1.32	<0.001	-$1.92	-$0.73	$11.00	-12.0%
Washington	Total	$2.17	0.51	-$3.25	$7.60	$140.88	1.5%
	Inpatient	$2.54	0.23	-$0.98	$6.06	$45.30	5.6%
	Skilled nursing facility	-$0.54	0.63	-$2.39	$1.31	$13.95	-3.9%
Average Medicare Spending per Day during FFS Home Health Episodes of Care							
Arizona	Total	-$3.85	0.34	-$10.51	$2.81	$170.20	-2.3%
	Inpatient	-$1.42	0.55	-$5.29	$2.45	$56.09	-2.5%
	Skilled nursing facility	-$0.33	0.51	-$1.15	$0.49	$5.56	-5.9%

	Medicare spending per day by type of service	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
		D-in-D	p-value	Lower 90% CI	Upper 90% CI		
Florida	Total	$0.26	0.84	-$1.83	$2.35	$145.88	0.2%
	Inpatient	-$1.45	0.04	-$2.60	-$0.30	$38.23	-3.8%
	Skilled nursing facility	$0.07	0.63	-$0.17	$0.30	$4.59	1.5%
Iowa	Total	-$12.57	0.001	-$18.83	-$6.31	$149.77	-8.4%
	Inpatient	-$5.28	0.05	-$9.79	-$0.78	$47.06	-11.2%
	Skilled nursing facility	-$3.78	<0.001	-$5.36	-$2.20	$9.65	-39.2%
Maryland	Total	$5.38	0.11	-$0.13	$10.90	$192.62	2.8%
	Inpatient	$2.47	0.29	-$1.40	$6.33	$76.09	3.2%
	Skilled nursing facility	$0.36	0.33	-$0.25	$0.97	$6.66	5.4%
Massachusetts	Total	-$6.30	0.02	-$10.80	-$1.80	$173.38	-3.6%
	Inpatient	-$4.84	0.01	-$7.91	-$1.76	$62.51	-7.7%
	Skilled nursing facility	-$0.66	0.16	-$1.44	$0.12	$9.32	-7.1%
Nebraska	Total	-$7.82	0.06	-$14.65	-$0.98	$150.41	-5.2%
	Inpatient	-$3.59	0.16	-$7.76	$0.59	$43.80	-8.2%
	Skilled nursing facility	-$1.38	0.19	-$3.11	$0.36	$9.41	-14.7%
North Carolina	Total	$2.31	0.24	-$0.93	$5.54	$143.49	1.6%
	Inpatient	$1.19	0.37	-$0.97	$3.36	$46.94	2.5%
	Skilled nursing facility	$0.29	0.28	-$0.15	$0.73	$4.42	6.6%
Tennessee	Total	-$6.45	0.002	-$9.88	-$3.03	$123.40	-5.2%
	Inpatient	-$2.46	0.04	-$4.38	-$0.53	$37.96	-6.5%
	Skilled nursing facility	-$0.65	0.01	-$1.08	-$0.22	$4.69	-13.9%
Washington	Total	$0.57	0.87	-$5.27	$6.41	$156.53	0.4%
	Inpatient	$2.46	0.31	-$1.53	$6.45	$47.14	5.2%
	Skilled nursing facility	-$0.47	0.52	-$1.68	$0.73	$6.94	-6.8%

CI= Confidence Interval.| These models include state-specific linear time trends. | Average is based on capped expenditure measures. Capping was done separately for total and for each component such that the component means do not add up to the total mean.

Exhibit C-63. Cumulative D-in-D Results at the State-Level, OASIS Outcome Quality Measures

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
Discharged to Community						
Arizona	-0.51	0.56	-1.93	0.91	76.3%	-0.7%
Florida	1.37	0.01	0.47	2.28	75.2%	1.8%
Iowa	-0.39	0.72	-2.18	1.39	67.4%	-0.6%
Maryland	0.99	0.31	-0.62	2.60	74.5%	1.3%
Massachusetts	1.11	0.28	-0.58	2.79	68.8%	1.6%
Nebraska	1.34	0.23	-0.48	3.15	73.1%	1.8%
North Carolina	0.08	0.90	-0.98	1.14	73.5%	0.1%
Tennessee	-2.75	<0.01	-4.14	-1.36	65.9%	-4.2%
Washington	-2.32	0.04	-4.18	-0.46	75.3%	-3.1%
Total Normalized Composite (TNC) Change in Self-Care						
Arizona	0.13	<0.01	0.05	0.20	1.24	10.2%
Florida	-0.01	0.75	-0.05	0.04	1.45	-0.6%
Iowa	-0.02	0.77	-0.13	0.09	1.29	-1.5%
Maryland	0.14	<0.01	0.06	0.22	1.45	9.4%
Massachusetts	-0.05	0.28	-0.14	0.03	1.36	-4.0%
Nebraska	0.002	0.96	-0.08	0.08	1.17	0.2%
North Carolina	0.02	0.68	-0.05	0.08	1.27	1.3%
Tennessee	0.004	0.91	-0.06	0.06	1.44	0.3%
Washington	0.07	0.33	-0.05	0.18	1.11	6.0%
Total Normalized Composite (TNC) Change in Mobility						
Arizona	0.04	<0.01	0.02	0.07	0.40	11.1%
Florida	-0.02	0.11	-0.03	0.0004	0.45	-3.6%
Iowa	0.002	0.91	-0.03	0.03	0.42	0.5%
Maryland	0.07	<0.001	0.04	0.10	0.46	14.9%
Massachusetts	-0.02	0.33	-0.05	0.01	0.43	-4.4%
Nebraska	-0.01	0.49	-0.04	0.02	0.38	-3.1%
North Carolina	0.01	0.36	-0.01	0.03	0.41	2.9%
Tennessee	-0.01	0.67	-0.03	0.02	0.48	-1.3%
Washington	0.01	0.54	-0.02	0.05	0.37	3.3%
Improvement in Dyspnea						
Arizona	3.39	<0.10	0.01	6.76	68.7%	4.9%
Florida	-4.49	<0.01	-6.90	-2.08	64.0%	-7.0%
Iowa	-1.74	0.63	-7.70	4.21	69.1%	-2.5%
Maryland	2.28	0.28	-1.22	5.78	75.6%	3.0%
Massachusetts	0.19	0.91	-2.75	3.14	69.4%	0.3%
Nebraska	-1.31	0.57	-5.14	2.52	67.4%	-1.9%
North Carolina	-1.22	0.48	-4.02	1.59	68.7%	-1.8%
Tennessee	2.71	0.14	-0.28	5.69	66.5%	4.1%
Washington	0.48	0.84	-3.52	4.47	65.1%	0.7%
Improvement Management of Oral Medications						
Arizona	10.09	<0.001	6.03	14.16	50.2%	20.1%
Florida	1.99	0.20	-0.54	4.51	46.9%	4.2%
Iowa	0.15	0.96	-4.42	4.72	62.3%	0.2%
Maryland	5.18	0.06	0.68	9.67	59.0%	8.8%

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
Massachusetts	-3.56	<0.10	-7.08	-0.05	61.4%	-5.8%
Nebraska	-1.46	0.71	-7.89	4.98	51.3%	-2.8%
North Carolina	2.53	0.29	-1.43	6.49	49.0%	5.2%
Tennessee	2.33	0.30	-1.37	6.03	54.2%	4.3%
Washington	5.06	0.13	-0.49	10.60	42.9%	11.8%
Improvement in Pain Interfering with Activity						
Arizona	4.13	0.02	1.12	7.13	65.2%	6.3%
Florida	0.04	0.97	-1.83	1.91	75.3%	0.1%
Iowa	-0.83	0.77	-5.39	3.74	70.3%	-1.2%
Maryland	1.56	0.46	-1.94	5.07	70.3%	2.2%
Massachusetts	-3.78	0.01	-6.29	-1.26	71.4%	-5.3%
Nebraska	-1.70	0.40	-5.05	1.64	68.3%	-2.5%
North Carolina	0.62	0.69	-1.98	3.22	67.3%	0.9%
Tennessee	2.48	0.14	-0.32	5.28	64.0%	3.9%
Washington	5.88	0.01	2.04	9.72	61.4%	9.6%
Improvement in Status of Surgical Wounds						
Arizona	1.52	0.45	-1.77	4.80	85.5%	1.8%
Florida	0.45	0.56	-0.83	1.73	91.9%	0.5%
Iowa	0.13	0.95	-3.25	3.52	86.4%	0.2%
Maryland	0.17	0.93	-2.97	3.31	90.5%	0.2%
Massachusetts	-0.44	0.73	-2.55	1.67	92.7%	-0.5%
Nebraska	5.57	0.21	-1.79	12.93	83.6%	6.7%
North Carolina	-1.59	0.16	-3.44	0.25	89.9%	-1.8%
Tennessee	2.63	0.02	0.75	4.50	88.8%	3.0%
Washington	0.54	0.85	-4.08	5.16	87.2%	0.6%

[a] Values represent percentage point changes. | HHVBP Measures indicated by italic text. | CI = Confidence Interval | These models include state-specific linear time trends.

Exhibit C-64. Cumulative D-in-D Results at the State-Level, 60 Day Mortality

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI	Upper 90% CI		
60 Day Mortality/All FFS Episodes						
Arizona	-0.74	<0.01	-1.16	-0.33	4.4%	-16.8%
Florida	0.03	0.69	-0.09	0.15	2.9%	1.0%
Iowa	-0.13	0.71	-0.72	0.45	4.4%	-3.0%
Maryland	0.02	0.93	-0.28	0.31	4.3%	0.5%
Massachusetts	0.01	0.97	-0.39	0.41	3.2%	0.3%
Nebraska	0.02	0.97	-0.73	0.76	4.2%	0.5%
North Carolina	-0.28	0.07	-0.53	-0.03	4.0%	-7.0%
Tennessee	0.002	0.99	-0.26	0.26	3.7%	0.1%
Washington	0.61	0.09	0.02	1.19	4.9%	12.4%

[a] Values represent percentage point changes. | CI = Confidence Interval.

Exhibit C-65. Cumulative D-in-D Results at the State-Level, HHCAHPS-Based Patient Experience Measures

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
How often the home health team gave care in a professional way (Professional Care)						
Arizona	0.10	0.82	-0.63	0.83	86.6%	0.1%
Florida	-0.31	0.12	-0.63	0.01	88.1%	-0.4%
Iowa	0.06	0.87	-0.49	0.60	87.7%	0.1%
Maryland	0.16	0.71	-0.54	0.86	88.3%	0.2%
Massachusetts	-0.83	0.05	-1.54	-0.12	88.3%	-0.9%
Nebraska	-0.18	0.67	-0.85	0.50	87.9%	-0.2%
North Carolina	0.49	0.01	0.17	0.81	89.8%	0.5%
Tennessee	0.59	0.02	0.17	1.00	90.1%	0.7%
Washington	0.37	0.30	-0.21	0.95	86.7%	0.4%
How well did the home health team communicate with patients (Communication)						
Arizona	0.26	0.62	-0.61	1.14	83.9%	0.3%
Florida	-0.44	0.05	-0.81	-0.07	85.1%	-0.5%
Iowa	-0.51	0.18	-1.14	0.11	86.1%	-0.6%
Maryland	0.58	0.22	-0.20	1.36	85.7%	0.7%
Massachusetts	-0.74	0.09	-1.47	-0.01	85.7%	-0.9%
Nebraska	-0.12	0.83	-1.04	0.80	86.1%	-0.1%
North Carolina	0.17	0.52	-0.26	0.59	87.5%	0.2%
Tennessee	0.55	0.05	0.10	1.00	87.9%	0.6%
Washington	-0.10	0.82	-0.81	0.61	83.9%	-0.1%
Did the home health team discuss medicines, pain, and home safety with patients (Discussion of Care)						
Arizona	0.26	0.64	-0.66	1.18	79.8%	0.3%
Florida	-0.76	<0.01	-1.19	-0.34	81.7%	-0.9%
Iowa	0.09	0.84	-0.67	0.86	85.5%	0.1%
Maryland	0.85	0.17	-0.18	1.88	82.5%	1.0%
Massachusetts	-0.92	0.06	-1.72	-0.13	84.2%	-1.1%
Nebraska	0.79	0.18	-0.18	1.77	83.4%	0.9%
North Carolina	0.19	0.57	-0.35	0.72	84.7%	0.2%
Tennessee	0.63	0.06	0.09	1.18	84.4%	0.7%
Washington	0.34	0.65	-0.90	1.59	80.5%	0.4%
How do patients rate the overall care from the home health agency (Overall Care)						
Arizona	0.38	0.62	-0.89	1.65	80.5%	0.5%
Florida	-0.18	0.55	-0.67	0.31	83.6%	-0.2%
Iowa	-0.21	0.70	-1.09	0.67	84.1%	-0.2%
Maryland	0.03	0.95	-0.80	0.86	83.7%	0.04%
Massachusetts	-1.02	0.15	-2.19	0.15	84.8%	-1.2%
Nebraska	0.47	0.57	-0.89	1.83	83.6%	0.6%
North Carolina	0.43	0.26	-0.19	1.06	86.1%	0.5%
Tennessee	0.63	0.10	0.00	1.27	86.4%	0.7%
Washington	1.05	0.13	-0.10	2.20	80.6%	1.3%
Would patients recommend the home health agency to friends and family (Likely to Recommend)						
Arizona	0.52	0.58	-1.03	2.07	75.2%	0.7%
Florida	-0.23	0.53	-0.81	0.36	78.5%	-0.3%
Iowa	0.88	0.16	-0.14	1.90	78.9%	1.1%
Maryland	0.57	0.48	-0.76	1.91	78.4%	0.7%

Measure	Model Estimates				Average in HHVBP States, Baseline (2013 – 2015)	Percent Relative Change
	D-in-D[a]	P-value	Lower 90% CI[a]	Upper 90% CI[a]		
Massachusetts	-1.01	0.18	-2.27	0.24	82.1%	-1.2%
Nebraska	0.59	0.54	-1.01	2.19	79.0%	0.7%
North Carolina	0.81	0.06	0.10	1.53	81.8%	1.0%
Tennessee	1.22	0.02	0.39	2.04	82.9%	1.5%
Washington	0.92	0.24	-0.37	2.21	77.1%	1.2%

[a]*Values represent percentage point changes. HHVBP Measures indicated by italic text. | CI = Confidence Interval.*

C.13 Agency Operational Changes Supporting Analyses

C.13.1 HHVBP Self-Reported Measures

Exhibit C-66. Reporting Rates for the Self-Reported HHVBP Measures in 2019, by HHA Characteristic

Agency Characteristics		All 3 Measures Reported (%)	All 3 Measures Reported (N)	Total Number of HHAs
All HHAs with a TPS		**80.8%**	**1236**	**1529**
Size Cohorts	Small HHAs	60.0%	51	85
	Large HHAs	79.7%	646	811
	Single Size (Statewide)	85.2%	539	633
Setting	Freestanding	80.3%	1126	1403
	Hospital-Based	87.3%	110	126
HHA Age	<4 Years Old	58.1%	25	43
	4-10 Years Old	67.0%	319	476
	>10 Years Old	88.3%	892	1010
Ownership Status	For-Profit	79.3%	931	1174
	Government-Owned	86.9%	73	84
	Non-Profit	85.6%	232	271
Chain Status	Chain - No	71.7%	622	868
	Chain - Yes	92.9%	612	659
	Chain - Information not available	100%	2	2
Size (# of OASIS episodes)	1-59	61.2%	41	67
	60-249	68.2%	259	380
	250-499	78.4%	240	306
	500-999	87.3%	248	284
	1000+	91.1%	448	492
2019 TPS Quartile*	First Quartile	67.0%	280	418
	Second Quartile	81.5%	255	313
	Third Quartile	88.4%	274	310
	Fourth Quartile	87.5%	427	488
CY 2021* Payment Adjustment Category	[-7%, -3%)	49.2%	65	132
	[-3%, -1%]	74.3%	243	327
	(-1%, 0%]	84.6%	242	286
	(0%, 1%]	88.5%	231	261
	(1%, 3%]	87.8%	308	351
	(3%, 7%]	85.5%	147	172

*HHA characteristics from CY 2019 | * CY 2021 Payment adjustments and TPS (announced to HHVBP HHAs in Fall 2020) were determined by HHA performance in 2019.*

C.13.2 Use of HHVBP Connect

C.13.2.1 Background

HHVBP Connect is an interactive web-based platform that launched in January 2016, coinciding with the beginning of HHVBP Model implementation. HHVBP Connect allows the HHVBP Technical Assistance (TA) staff and HHAs in the nine intervention states to securely communicate with each other and share best practices for improving performance and quality among competing HHAs. The resources available on the HHVBP Connect website include the latest updates on the HHVBP Model, webinars, newsletters, Frequently Asked Questions (FAQs), quality improvement tools, materials regarding HHVBP performance measures (e.g., benchmarks and achievement thresholds, when to submit New Measures data, information on how to retrieve performance reports), and other information pertinent to the HHVBP Model.[48]

As part of our evaluation, we assess use of the HHVBP Connect website and its resources to answer these research questions: To what extent did participants use the technical assistance provided? How did use change across the first four performance years of the HHVBP Model?

C.13.2.2 Approach & Methodology

We assessed use of the HHVBP Connect site by reviewing 2019 data on monthly unique visitors, resource downloads, webinar participation, and online posts provided by the HHVBP Technical Assistance (TA) contractor. We also conducted a manual count of HHVBP Connect "Chatter" activity to obtain data regarding posts and responses by HHAs versus non-HHAs. The majority of the data provided by the TA contractor did not include information that allowed for identification of individual HHAs. However, most of the data included flags for HHA user type (including HHVBP Practice Users, HHVBP Administrator, and other non-HHA user types)[49]. This information allowed us to determine that between 97.8 –100 percent of users (depending on the resource) represent HHAs in the HHVBP states. The 2.2 percent of HHVBP Connect users who do not represent HHA users include TA staff and other HHVBP contractors. Exhibit C-67 below identifies the populations used for analysis of each type of HHVBP Connect activity or resource.

Exhibit C-67. Population Analyzed for Each HHVBP Connect Activity/Resource

HHVBP Connect Activity/Resource	Description of Population
Monthly Unique Visitors	All HHVBP Connect Users*
Resource Downloads	All HHVBP Connect Users*
Webinar Participation	HHAs Only
"Chatter" Activity	All HHVBP Connect Users*

**Based on available data, approximately 97.8% of all HHVBP Connect users are HHAs (identified via the HHVBP Connect user profile name variable sent by the TA contractor).*

C.13.2.3 Summary of Participation and Resource Use

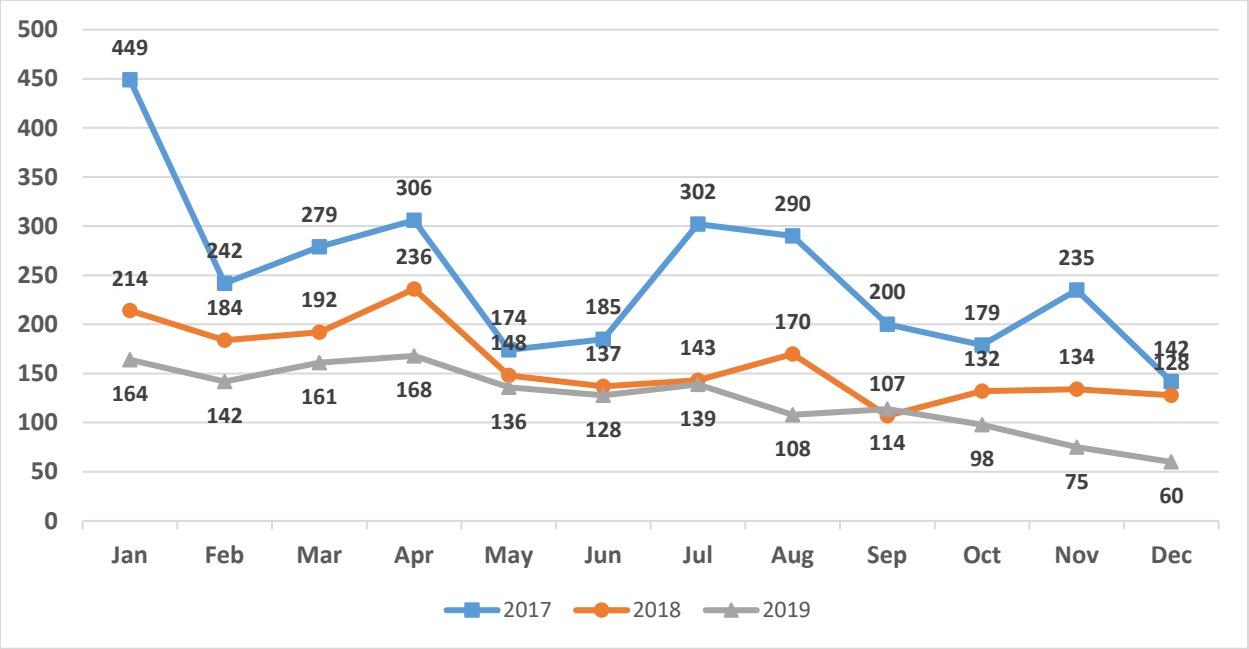
Monthly Unique Visitors to HHVBP Connect

Since 2017, the HHVBP TA Contractor has tracked the number of monthly unique visitors for all HHVBP Connect users via weekly dashboards. Users are required to enter a user name and password for each login to the HHVBP Connect website. The most current numbers continue an overall downward trend in

[48] CMS (2016) Home Health Value-Based Purchasing Model. Accessed from here on September 10, 2020.
[49] Primarily, CMS staff and its contractors.

monthly unique visitors from previous years (Exhibit C-68). In 2019, monthly unique visitors ranged between 60 – 164. The number of visitors in 2019 was lower for all months relative to months in previous years except for September.

Exhibit C-68. Monthly Unique Visitors to HHVBP Connect in 2017 – 2019, by Month



Data include unique logins by all HHVBP Connect users, 97.8% of whom are HHAs. Data not available for 2016.

Use of HHVBP Connect Library Resources and Live Webinar Participation

The most frequently used HHVBP Connect resources in 2019 were downloading files posted in the website's library and participation in live webinars. This was consistent with use of HHVBP Connect in prior years.

Download of HHVBP Connect Library Resources

To provide assistance to HHAs, the HHVBP TA Contractor made several resources available in the HHVBP Connect Library on a broad range of topics and categories. Throughout 2019, the HHVBP TA Contractor created 105 different library resources that were downloaded from the HHVBP Connect website in a variety of formats, including audio webinar recordings and documents (e.g., PDFs, Excel files).

In order to understand the types of content most frequently downloaded by users in each year of the HHVBP Model, we grouped the library resources into three broad domains and counted the number of downloads corresponding to each domain (Exhibit C-69). These domains are similar to those from the first three years of the HHVBP Model (2016 – 2018), allowing for a comparison across years. As in previous years, we focus the analysis on downloads among the resources created in 2019.[50]

- Domain 1 encompasses regular updates on the HHVBP Model (i.e., newsletter and FAQs) as well as model guides, environmental scans, and background material about the HHVBP Model. The number of Domain 1 downloads in 2019 (1,806 downloads) represents a slight decrease from 2018 (2,106 downloads; 14 percent decrease) and from 2016 (2,177 downloads; 17 percent

[50] We note that model participants also continued to download materials that were created in earlier years of the model, with 1,826 downloads of 160 resources that were posted prior to 2019.

decrease), all of which were substantially less than the number of downloads in 2017 (3,213 downloads).

- Domain 2 includes materials to help HHAs understand and use resources and websites pertinent to the HHVBP Model, including HHVBP Connect and the HHVBP Secure Portal. As to be expected, use and availability of these resources was much higher in 2016 when the Model was new, and lower in all subsequent years as the need for new materials decreased and HHAs became more familiar with these resources.
- Finally, Domain 3 includes materials developed by the TA Contractor to facilitate quality improvement (QI). These resources evolved slightly from an initial focus on understanding HHVBP measures and data in 2016 to providing guidance on improving on specific measures, more advanced understanding of TPS calculations, payment adjustments, and other quality improvement resources in subsequent years. Resources assisting with claims measures were the most prevalent QI resources downloaded in both 2019 and 2018, as opposed to 2017, where resources about OASIS measures were most common in this domain. This shift in resources aimed at claims-based measures may in part reflect the change to the TPS that was announced in July 2018 and that took effect in January 2019, which more heavily weights the two claims-based HHVBP measures.[51]

Exhibit C-69. HHVBP Connect Resource Domains and Downloads in 2019

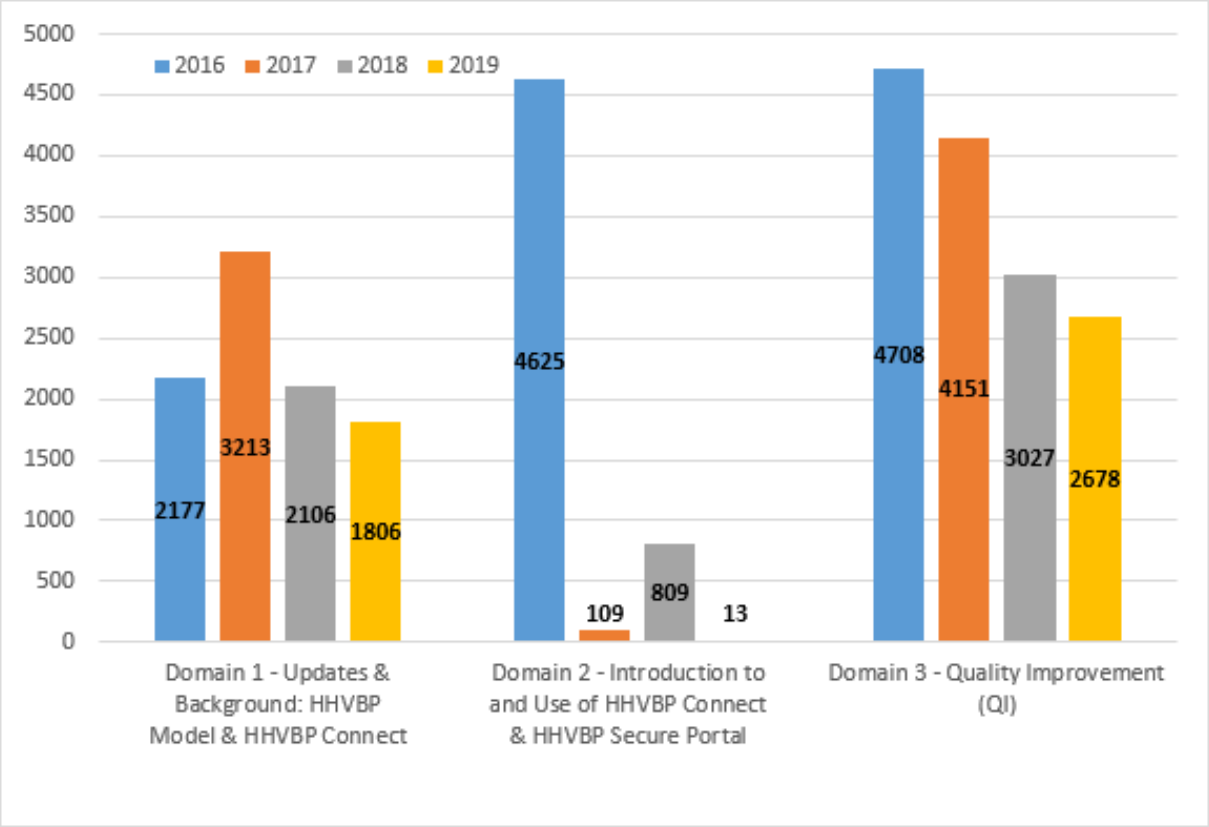
HHVBP Connect Domains	Number of Resources	Number of Total Downloads	Number of Downloads per Resource
Domain 1 – Updates & Background: HHVBP Model & HHVBP Connect	**42**	**1,806**	**43.0**
Monthly Updates – Newsletters & FAQs	*28*	*1,456*	*52.0*
Model Guides, Environmental Scans, & Background Information	*14*	*350*	*25.0*
Domain 2 – Introduction to and Use of HHVBP Connect & HHVBP Secure Portal	**1**	**13**	**13**
New Measure Submission	*0*	*0*	*0*
Introduction/Registration, User Manual, HHVBP Connect vs Secure Portal	*1*	*13*	*13*
Domain 3 – Quality Improvement (QI)	**62**	**2,678**	**43.2**
Specific HHVBP Measures	*27*	*1,334*	*49.4*
OASIS Measures	6	175	29.2
Claims Measures	10	641	64.1
HHCAHPS Measures	10	445	44.5
New Measures	1	73	73.0
TPS Calculation & Payment Adjustments	*13*	*724*	*55.7*
Interim Performance Reports	*0*	*0*	*0*
Other General Improvement Strategies	*16*	*410*	*25.6*
Organizational Assessment Tools & Plans	*6*	*210*	*35.0*
Total Downloads	***105***	***4,497***	***42.8***

Data include downloads by all HHVBP Connect users, approximately 97.8% of whom are HHAs.

[51] See 2019 Final Rule. Available here.

The majority of downloads in 2019 were for resources from Domain 3 (Quality Improvement), followed by Domain 1 (Updates & Background) (Exhibit C-70). When comparing resource downloads across the first four years of the model, the total number of downloads continually decreased. The 4,497 total downloads in 2019 represents a 61 percent decrease from 2016 (11,510 downloads), 40 percent decrease from 2017 (7,473 downloads), and a 24 percent decrease from 2018 (5,942 downloads) (not shown). In addition to resources that were created in 2019, model participants continued to download materials that were posted in earlier years of the model, too, with 1,826 downloads of 160 resources that were posted prior to 2019 (not shown).

Exhibit C-70. Total Number of Resource Downloads by Domain and Description of Changes across HHVBP Model Years, 2016 – 2019

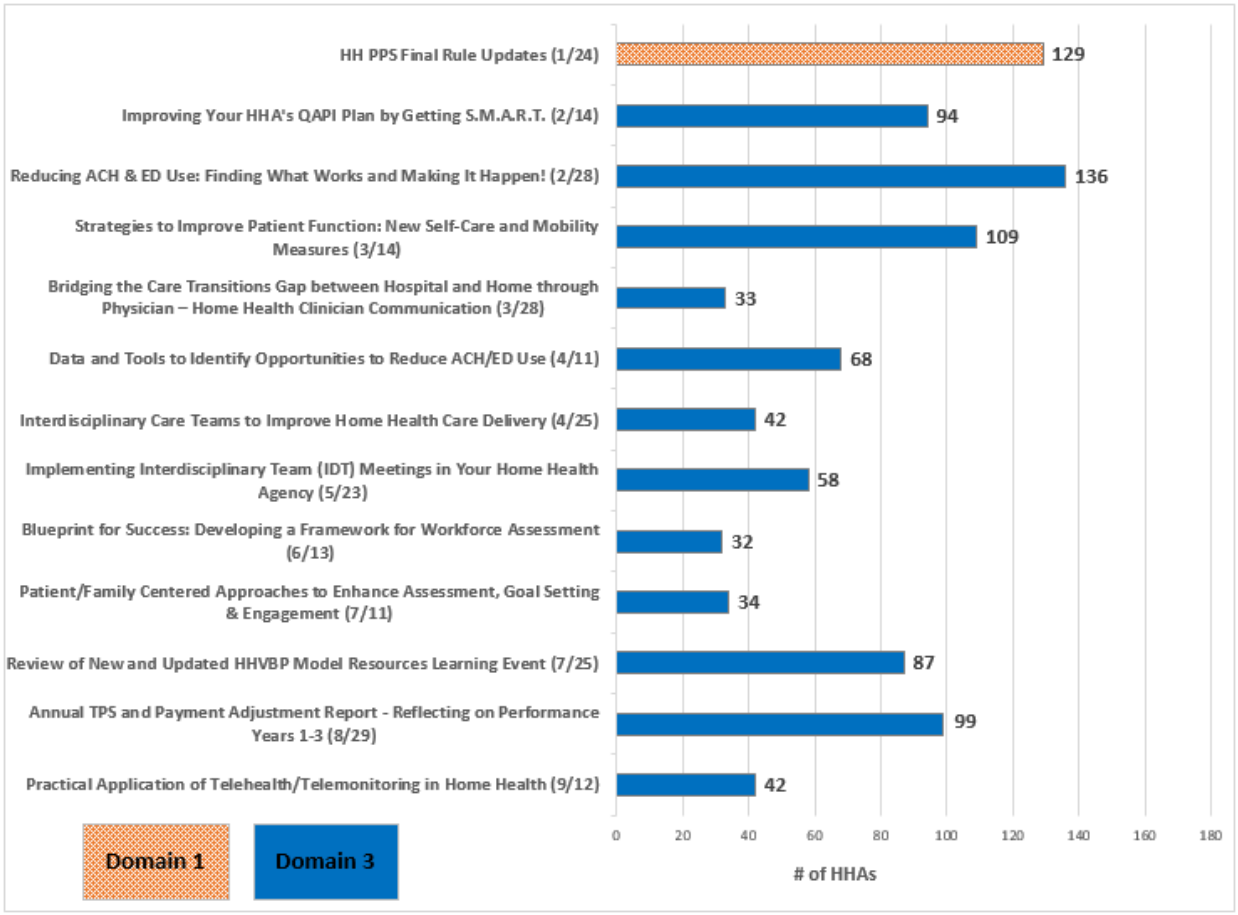


HHVBP Connect Webinar Participation

In addition to resources available in the library, the HHVBP TA Contractor hosted 13 webinars for HHAs on HHVBP Connect throughout 2019. Exhibit C-71 showcases the webinar topics, webinar date, and attendance by HHAs, listed by date of webinar. These data refer to live attendance to the online event and reflect HHAs only (i.e., does not include non-HHA participants). The webinar topic with the highest attendance was “Reducing ACH & ED Use: Finding What Works and Making It Happen!” in February 2019 (136 participants). The interest in this webinar may also be due to the increased weighting of the claims-based measures in the annual TPS calculation. The average number of participants per webinar was 74. This is slightly higher than the average of 69 attendees in 2018, but lower than average attendance in 2017 and 2016 (155 and 400, respectively). Similarly, the total number of cumulative webinar participants in 2019 (963 participants for 13 webinars) was comparable to 2018 (963

participants for 14 webinars) but lower than in 2017 (2,398 participants for 15 webinars) and in 2016 (6,408 participants for 15 webinars) (not shown).

Exhibit C-71. HHVBP Connect Webinar Topics and Participation in 2019 by Domain



Data include HHAs only. Webinar participation refers to attendance during the live online event.
No webinars were classified to Domain 2.

Participation in HHVBP Connect's "Chatter" Feature

The HHVBP Connect website's "Chatter" feature provides an interactive online community where HHAs are invited to "post status updates, share files and links with other users, 'like' posts and documents, 'follow' people and groups, and share tools, resources, and documents with other users and groups."[52]

We used a manual count to track the "Chatter" feature's use by HHAs in 2019. "Chatter" activity includes online posts and subsequent responses. Users of the "Chatter" feature, who include both HHAs and HHVBP TA Contractor staff, posted 85 times during 2019, with approximately 7 posts per month on average (Exhibit C-72). This is similar to 2018 (8 posts per month) but a decrease from both 2016 (31 posts per month) and 2017 (11 posts per month; Exhibit C-72).

[52] "HHVBP Connect Website Overview" Slides from February 11, 2016 Webinar.

Exhibit C-72. HHVBP Connect "Chatter" Activity by All HHVBP Connect Users in 2016, 2017, 2018 and 2019 by Month

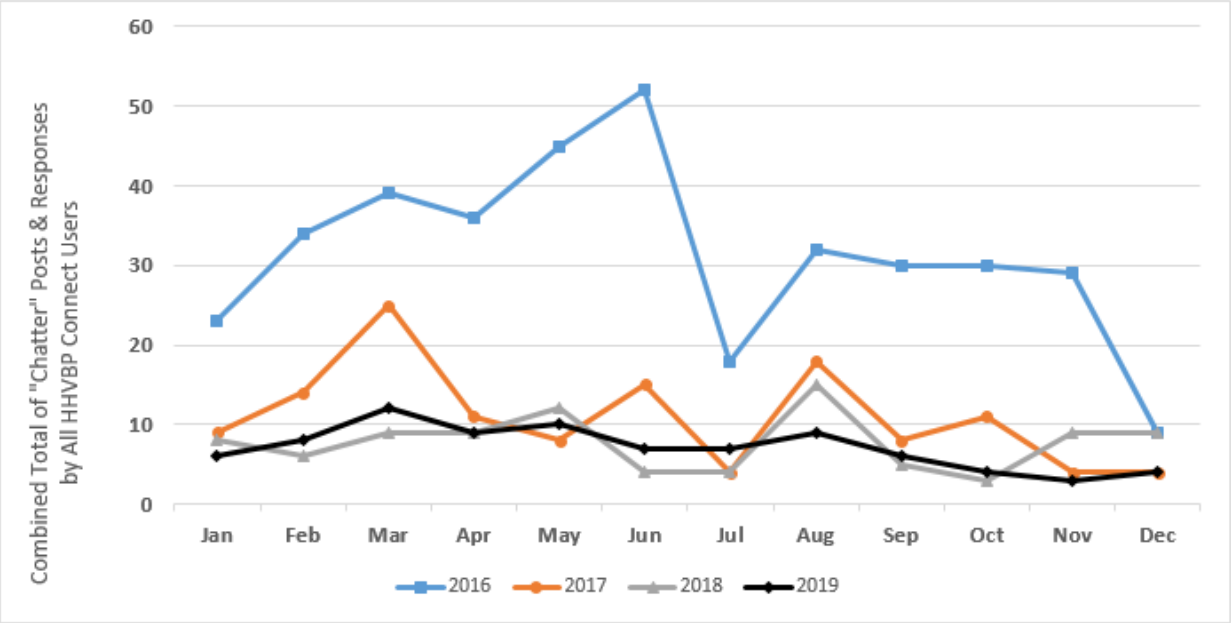


Exhibit C-73 below summarizes the "Chatter" activity between the TA Contractor and HHAs for each of the first four years of the HHVBP Model. Similar to 2017 and 2018, HHVBP TA staff accounted for the majority of the "Chatter" feature activity in 2019 (74 of the 85 posts and responses). Their posts and responses were focused primarily on the promotion of upcoming online events (e.g., a webinar) or newly available resources (e.g., an updated FAQ document). This content and number of posts by HHVBP TA staff were similar to prior years. Similar to other HHVBP Connect activities discussed above, "Chatter" activity by HHVBP TA staff and HHA users has declined from the first two years of the model.

Exhibit C-73. "Chatter" Posts and Responses by TA Contractor and HHAs in 2016, 2017, 2018 and 2019

	2016	2017	2018	2019
HHVBP TA Staff Total	**163**	**89**	**72**	**74**
Posts	*76*	*69*	*52*	*64*
Responses	*87*	*20*	*20*	*10*
HHA Users Total	**219**	**32**	**21**	**11**
Posts	*29*	*11*	*16*	*9*
Responses	*190*	*20*	*5*	*2*
Total	**382**	**121**	**93**	**85**