Methodology for Developing the Six Hospital-Based Episode Measures: Supplemental Documentation for the Fiscal Year (FY) 2015 Inpatient Prospective Payment System and Long-Term Care Hospital Prospective Payment System Proposed Rule

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1 INTRODUCTION

As discussed in the FY 2015 IPPS/LTCH Proposed Rule, the Centers for Medicare & Medicaid Services (CMS) is considering six new payment-standardized, risk-adjusted hospital-based episode of care (or "episode") measures to supplement the Medicare Spending per Beneficiary (MSPB) measure in the Efficiency domain of the Total Performance Score (TPS) in the Hospital Value-Based Purchasing (VBP) Program. This document serves as a technical supplement to that discussion, providing further detail on episode selection and construction. These measures would capture clinically relevant Medicare Part A and Part B payments[1] in an episode window similar to the MPSB episode measures, spanning 3 days prior to a hospitalization through 30 days post-discharge for all discharged beneficiaries with the episode conditions.

Acumen, LLC ("Acumen"), in partnership with CMS and under contract to support the Hospital Value-Based Purchasing (VBP) Program (contract number GS-10F-0133S, HHSM-500-2011-00098G), has developed six new payment-standardized episode measures by adapting the methods from the MSPB measure to include only services occurring during the episode window that are clinically related to the episode condition. Hospitalization for the specific episode condition would trigger the start of the episode and the standardized payments for clinically relevant services provided during the episode window would be included in the measure. These payment-standardized episode-specific measures would then be risk-adjusted and attributed to the hospital responsible for the index admission. The payment measure would utilize the MSPB risk adjustment methodology with minor adaptations to account for the episode construct (see Section 4).

This document details the method used to construct the hospital-based episode payment measures. Section 2 explains the criteria used to select conditions for episode development. Section 3 outlines the methodology for constructing the episodes from Medicare administrative claims. Section 4 details the calculation of the episode-based measures, and Section 5 describes the attribution rules. Finally, Section 6 presents the results of the six hospital-based episode measures using calendar year 2012 Medicare Parts A and B claims data.

[1] We define Medicare payments to include payments made by Medicare and other payers including the beneficiary (i.e., allowed charges).

2 SELECTING CONDITIONS/PROCEDURES FOR EPISODE CONSTRUCTION

This section describes the criteria used to select the six medical and surgical conditions for initial episode construction. In Section 2.1, we describe the criteria used for selecting episode conditions. Section 2.2 lists prioritized conditions and procedures based on these selection criteria.

2.1 Criteria Used to Prioritize Hospital-Based Conditions and Procedures

The following criteria were used to prioritize and identify conditions and procedures most appropriate for initial development as hospital-based episode measures: (1) share of Medicare payments for care during and following an acute inpatient (IP) hospital stay; (2) the degree to which clinical experts consulted for this project agree that standardized Medicare payments for services provided during the episode can be linked to the care provided during the hospitalization; (3) proportion of payments for post-acute care, indicating episode payment differences are driven by utilization outside of the MS-DRG payment; (4) amount of variation in post-discharge payments enabling differentiation between hospitals for that episode; and (5) condition is managed by general medicine physicians including hospitalists or surgical subspecialists, reflecting CMS priorities in measuring care for these types of providers. These selection criteria were applied in a hierarchical manner to the potential trigger events which was defined by calendar year 2012 Medicare acute hospital inpatient data aggregated by Diagnosis-Related Group (DRG) family. The MS-DRG classification system includes groups of DRGs that reflect varying degrees of complications and comorbidities. For the purposes of this prioritization, we treated these groups as DRG families rather than evaluating each MS-DRG individually. The first consideration was the share of total Medicare payments (defined for this purpose as the IP hospital payment for that DRG plus 30-day post-discharge total Medicare Part A and B payments). Second, the influence of hospital treatment on near-term outcomes was considered to rule out conditions where the hospital and practitioners at the hospital responsible for the beneficiary's care do not have as much influence on immediate outcomes (e.g., renal failure where hospital providers' care is often supportive and the patient's trajectory is influenced more by the natural history of the primary cause of renal failure). Third, for DRG families that met these two criteria, the share of post-acute care payments and normalized mean standard deviation were assessed to inform which conditions have the greatest potential for post-discharge discretionary services (i.e., high post-acute care payments and high standard deviation of post-discharge payments signifying a large range in practice patterns during the post-discharge period). Finally, we considered the type of hospital-based physicians primarily responsible for the care of patients with the condition/surgery.

2.1.1 Share of Medicare Payments

The first criterion ensures that the condition or procedure encompasses a substantial portion of Medicare payments relative to all potential conditions or procedures managed in the hospital setting. Medicare payments considered for this criterion include Part A IP hospital payments and all Part A and B payments initiated after hospital discharge and for 30 days. These payments were selected for defining this prioritization criterion as they represent those most likely to be influenced by the care provided during the initial hospital stay. Conditions with the greatest share of costs would then be prioritized. The 30 day time window after discharge was selected for defining total payments because it is consistent with the Medicare Spending per Beneficiary (MSPB) measure currently employed by CMS and recently endorsed at the hospital level by the National Quality Forum (NQF).

2.1.2 Provider Influence on Outcomes

The second criterion considers the influence of the initial hospital care provided for a condition or procedure on near-term patient outcomes. This criterion is included because hospital care is likely to influence post-discharge payments and health outcomes more heavily for some conditions or procedures than for others and we desired to prioritize conditions strongly influenced by the care provided during the initial hospital stay. For example, a hospital-based physician is likely to have a higher influence on the final outcome and payments of a patient suffering from a condition like pneumonia (e.g., progression to sepsis and disseminated disease) versus a bone fracture for which the contribution from a hospitalist would be limited (e.g., medical management of pain). The role of the hospital-based physician was thus considered to ensure a strong influence on episode period medical events. This was determined by clinical expertise through discussions with hospital-based specialists (biographical information in Appendix C).

2.1.3 Post-Acute Care Payments

The third criterion prioritizes conditions or procedures that tend to have high post-acute care payments during the episode window. This represents the potential for efficiency improvements in post-acute service utilization. Because Medicare acute inpatient hospital payments are made under the inpatient prospective payment system (IPPS), which employs fixed rates based on average resource utilization, much of the variation in payments associated with hospital events occurs after discharge from the initial inpatient stay. Conditions and procedures for which post-acute care accounts for a large percent of episode payments provide hospitals with a stronger incentive to efficiently manage post-acute care services. To define post-acute

care, Acumen employed the MSPB definition of post-acute care, which is outlined in the *MSPB Measure Information Form* available on QualityNet.[2]

2.1.4 Variation in Medicare Payments

The fourth criterion evaluates the range in payments for patients hospitalized with the condition or surgery. Conditions with large variations in payments or health outcomes would make better candidates for inclusion in an efficiency measure because the large variation suggests a wide range of clinical practice patterns that, if narrowed, could lead to greater efficiency. Thus, good candidates for inclusion in a value measure exhibit a wide range of potential payment outcomes, which represent either widely varying health outcomes or discretionary choices regarding post-acute or treatment care. Variation in payments is measured using the metric of mean normalized standard deviation.

2.1.5 Type of Treating Physician

The last consideration applied by the development team was the treating physician specialist type for each potential condition. For initial episode development, CMS desired that both acute medical and surgical conditions should be represented, and that certain hospital-based physician types were of high priority for representation such as general medicine physicians including evaluating the important role of hospitalist physicians and surgical subspecialists such as orthopedic surgeons.

2.2 Prioritized Conditions and Procedures for Episode Construction

Using the criteria described above, we identified the top medical and surgical conditions for moving forward into episode development. Selection is focused on DRG families to define the hospital conditions. The following subsections present the results of the selection analysis for hospital conditions and procedures.

2.2.1 Prioritized and Selected Medical Conditions

The prioritized medical conditions defined by their DRG family included: (1) kidney and urinary tract infections, (2) cellulitis, (3) pulmonary edema and respiratory failure, (4) gastrointestinal hemorrhage, (5) pulmonary embolism, (6) pancreatic disorders, (7) sepsis, and (8) pneumonia. These priority conditions demonstrated the combination of high payments, substantial provider influence on episode period outcomes, and substantial post-acute care payments. As CMS desired the first set of medical conditions to be primarily managed by a general medicine physician, or hospitalist, as a way to understand variation where hospitals have

[2] QualityNet, "MSPB Measure Information Form" (Revised May 2013), https://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1228772057350

a high degree of influence and also where variation may not widely be understood or studied, this list represents that restriction. Thus, conditions managed substantially by other medical specialists such as cardiologists or neurologists (acute myocardial infarction or stroke) were not included for initial prioritization. After reviewing the above prioritized condition list, the development team chose to focus on three high-priority hospital-based conditions for initial episode development: kidney/urinary tract infection, cellulitis, and gastrointestinal hemorrhage.

2.2.2 Prioritized and Selected Surgical Procedures

The preliminary list of prioritized surgical procedures based on surgical DRG families were: (1) major joint replacement or reattachment of lower extremity, (2) hip and femur procedures (except major joint), (3) major small and large bowel procedures, (4) spinal fusion except cervical, (5) other vascular procedures, (6) cardiac valve and other major cardiothoracic procedures without cardiac catheterization, (7) permanent cardiac pacemaker implant, and (8) laparoscopic cholecystectomy. These priority surgical conditions demonstrated the combination of high Medicare payments, high provider influence on outcomes, and substantial post-acute care Medicare payments with a high degree of variation.

While medical DRGs are specific enough to identify medical conditions for defining episodes for provider profiling, the surgical DRG families are too broad to identify specific surgical procedures that are useful for provider profiling. Thus, Acumen assessed the most common surgical procedures (identified by ICD-9 procedure code) within several prioritized DRGs to select specific surgical procedures for episode development. The surgical DRGs prioritized based on the selection criteria were (1) major joint replacement or reattachment of lower extremity, and (2) spinal fusion except cervical. The most frequent surgical procedures within these surgical DRG were identified as: (1) hip replacement or revision, (2) knee replacement or revision, and (3) lumbar spinal fusion or refusion. For each of these specific procedures, Acumen developed an ICD-9 procedure code definition that included all surgical techniques available for performing the hip replacement/revision, knee replacement/revision, or lumbar spinal fusion/refusion. For example, for hip replacement, we included all total hip, partial hip, and hip resurfacing procedures – all of which are surgical options for treating a worn-out hip joint. In addition, procedures performed for the treatment of hip fractures were excluded, as were bilateral hip and knee surgeries and staged lumbar spine fusion and refusion procedures. Trigger codes for selected episodes are listed in Appendix A.

3 HOSPITAL-BASED EPISODE CONSTRUCTION METHODOLOGY

Following the selection of episode conditions and identification of their trigger codes, Acumen developed the episodes through the use of empirical data analysis and clinical logic application. The methodology first groups services for major medical events (i.e., readmissions, emergency room (ER) visits, major outpatient procedures, skilled nursing facility stays) based on the most specific clinical information on the claims describing each event type. Next, the remaining Part B services are grouped (i.e., included in the episode) based first on the relevance of the service to the episode condition or, if not specific enough, also considering its associated diagnostic information on the claim. These grouping determinations are only applied to services that meet a minimum threshold for share of Medicare payments during the episode window. This payment threshold was used to improve the degree to which providers could make changes to clinical processes based on the episode measures by focusing on services with consequential Medicare payments, rather than a voluminous amount of services each accounting for only a small share of overall payments.

This section presents an overview of the methodology for constructing the hospital-based episode measures, followed by a more detailed description of the episode construction process. Section 3.1 outlines the process involved in constructing the hospital-based episodes, and Section 3.2 presents the methodology for defining the hospital-based episode measures.

3.1 Episode Construction Overview

Episodes are constructed by developing definitions specific to each episode condition for three steps: (1) *opening the episode,* (2) *grouping services to the episode, and* (3) *closing the episode.* These three steps in constructing an episode use a combination of "business rules" and billing codes specific to each episode condition to define an episode. Descriptions of each step are as follows:

1. Opening (also referred to as "triggering"): episodes are opened by the presence of specific billing codes on an IP claim indicating the episode condition/procedure was present,
2. Grouping services: clinically related services are grouped to the episode according to clinical logic defining relatedness based on billing codes and diagnoses in the claims, and
3. Closing: episodes are ended after a fixed length of time appropriate for the condition.

Grouping services is the most involved step in episode development. The methodology groups services based on assessing service categorizations (i.e. claims data components or aggregations) for relevance to the episode condition. These service categorizations can be defined by Medicare setting, claim type, or services recorded on claims either alone or with

diagnostic information. Clinical logic is applied to information on these service categorizations to determine relevance of the claim to the episode. These service categories, described in more detail in Section 3.2.1 and outlined under the Grouping Services construction step in Table 1, are assessed in the claims to determine whether they contain information meeting the episode construction criteria in Table 1. These rules are typically based on the *diagnosis or service codes* present on Medicare claims, but can also be based on the time from the trigger event (for home health and skilled nursing). Table 1 describes the information used in tandem with the clinical logic (see Section 3.2.3) to determine each step in the episode construction process.

Table 1. Information Used in Each Step of Episode Construction

Episode Construction Step	Information Used to Construct Episode
Opening (Triggering)	**For medical conditions:** medical DRG on inpatient (IP) claims **For surgical procedures:** surgical DRG with an ICD-9 procedure code on IP claims
Grouping Services	**For both medical and surgical episodes according to these service categorizations:** *Inpatient claims (readmission):* DRG or DRG and diagnosis or procedure code on the IP claim *Emergency room (ER) claims:* diagnosis on the ER evaluation and management (E&M) claim *Major outpatient procedures:* Ambulatory Payment Classification (APC) codes or APC and diagnosis (ICD-9) codes *Other Part B and Physician Claims:* service (Current Procedural Terminology, Fourth Edition codes – CPT-4s) or CPT-4 and diagnosis (ICD-9) codes *HH:* home health service type[3] or service type and diagnosis (ICD-9) codes *SNF:* grouped if linked to a qualifying IP stay that is also the trigger event
Closing	**For both medical and surgical episodes:** 30 days fixed period after trigger hospital discharge

3.1.1 Opening (Triggering) Episodes

Opening, or triggering, an episode involves the initiation of an episode based on the triggering rule being satisfied in the claims data. This involves the assessment that a particular claim has the exact procedure, diagnosis or service that meets the rule for starting an episode. Specific billing codes, or "trigger codes," on an appropriate claim constitute the basic

[3] Home health (HH) service types are identified by the following six revenue center codes: physical therapy (042x), occupational therapy (043x), speech language pathology (044x), skilled nursing (055x), home health aide (057x), medical social services (056x).

formulation of a trigger rule. Trigger rules are principally based on Diagnosis-Related Groups (DRGs) from IP claims, but may sometimes require additional ICD-9 diagnosis or procedure specifications also being met. Clinical reviewers assessed and approved the trigger codes for each episode.[4]

For both medical and surgical episodes, the opening logic requires a specific DRG to be assigned to an IP claim, with surgical episodes also requiring an ICD-9 procedure code on the IP claim. DRG families were found to provide sufficient specificity to identify inpatient hospital stays for medical conditions, while ICD-9 procedure codes are required for the surgical DRGs to identify the desired set of surgical inpatient stays for developing sufficiently homogenous (i.e., similar patient experience and expected outcomes) episodes. Consistent with the MSPB measure, the episode window begins three days prior to the trigger inpatient admission and continues for 30 days after discharge from the trigger stay to account for clinically relevant services (e.g., physician consultants, diagnostic tests, complications) occurring in the preadmission and post-discharge periods. Table 2 below defines the criteria used to open each of the hospital-based episodes.

Table 2. Hospital-Based Episode Trigger Rules

Episode	Trigger Rule
Cellulitis	Inpatient hospital admission with an MS-DRG that is a trigger for cellulitis
GI Hemorrhage	Inpatient hospital admission with an MS-DRG that is a trigger for GI hemorrhage
Kidney / Urinary Tract Infection	Inpatient hospital admission with an MS-DRG that is a trigger for kidney/urinary tract infection
Hip Replacement / Revision	Inpatient hospital admission with an MS-DRG and procedure code that are triggers for hip replacement/revision, with a hip replacement/revision surgical Current Procedural Terminology, Fourth Edition (CPT-4) code billed in Part B during the IP stay
Knee Replacement / Revision	Inpatient hospital admission with an MS-DRG and procedure code that are triggers for knee replacement/revision, with a knee replacement/revision surgical CPT-4 code billed in Part B during the IP stay
Lumbar Spine Fusion / Refusion	Inpatient hospital admission with an MS-DRG and procedure code that are triggers for lumbar spine fusion/refusion, with a lumbar spine fusion/refusion surgical CPT-4 code billed in Part B during the IP stay

In contrast to the MSPB measure, the hospital-based episode measure allows inpatient readmissions occurring in the post-discharge period to trigger a new episode if the readmission meets an episode's trigger specifications. The payments for these IP readmissions are thus included in two episodes: (1) grouped to the episode with the relevant preceding trigger stay, and (2) included as the inpatient trigger admission for a second episode. The readmission during the episode window may be to a different hospital than the preceding admission. Grouping this second admission to the preceding relevant episode maintains consistency in the method across episodes; and, allowing it to start its own episode comprehensively captures each hospital's efficiency, without an unnecessary loss of useful information.

[4] The list of trigger codes for each episode type is listed in Appendix A.

To illustrate the readmission trigger rules, we present two hypothetical scenarios of readmissions that are grouped to a first episode while also triggering a second episode: (1) a readmission for the same condition treated during the initial hospital stay, and (2) a readmission for a second condition that is a complication of inpatient treatment for the first condition and is also an episode trigger. In the first scenario, if a beneficiary had a hip replacement and was readmitted 20 days after discharge for a hip revision, the readmission would be grouped to the first hip replacement/revision episode and would also begin a new hip replacement/revision episode. In the second scenario, consider a hypothetical hip replacement episode with a readmission in the post-discharge period for cellulitis. If cellulitis is a complication of a hip replacement, it functions as both a complication (and is identified as such during the clinical review process) of the hip replacement episode and as a trigger for a new cellulitis episode.

3.1.2 Grouping Services

After an episode is opened, the claims submitted during the episode window are assessed for relevance to the episode condition/procedure. Those claims meeting the grouping rules are assigned to the episode for further calculation in the measure. The grouping rules identify and aggregate related services provided for the diagnosis, treatment, or follow up of the medical condition/procedure and its complications. Grouping rules are based on clinically vetted relevant service, procedure or diagnosis codes in valid claim settings. As detailed in Table 1, the grouping rules vary by type of service and are further discussed in Section 3.2.3.

3.1.3 Closing Episodes

The final step in episode construction is determining when the episode is completed. The grouping algorithm utilizes a fixed window of time after a trigger event to scan for related claims to assign to the episode. Medical and surgical episodes both end 30 days following discharge from the trigger inpatient stay. The 30 day period was chosen to maintain alignment with the MSPB measure which uses the same window period. Consistent with the MSPB measure, all claims that begin within the 30 day post-discharge period are considered for grouping, including home health or skilled nursing facility claims that may have end dates that extend beyond the episode window. For example, if a 90-day skilled nursing facility stay begins in the second week of the 30-day post-discharge period and is billed in three claims representing 30 days each, the claim for the first 30-days of care will be grouped to the episode but the second two 30-day claims will not.

3.2 Methodology for Defining the Hospital-Based Episodes

To facilitate the episode construction outlined in Section 3.1, Acumen processed the Medicare Parts A and B claims data into clinically meaningful service categories for review by

clinician experts. The process of developing the logic for grouping medical services proceeded in three general steps:

1. Organize claims into clinically informative service groupings,
2. Perform empirical data analysis to identify those services accounting for a substantial share of Medicare payments occurring in the preadmission and post-discharge periods,
3. Conduct clinical review of these services to select events and services clinically relevant to the episode.

The universe of claims for Medicare Parts A and B in calendar year 2012 was used to develop the hospital-based episodes. The first step identified all inpatient trigger stays and aggregated the Medicare claims occurring during the episode window into the clinically meaningful service categories. The second step splits Medicare claims into those occurring during the 3 days prior to trigger admission (preadmission period), the admission period (during stay period), or the 30 day period after discharge (post-discharge period). Services that met a minimum payment threshold (described in Section 3.2.2) were moved to the next step of clinical review. The third step involved a clinical review of empirical analysis based on the service categorizations to determine whether they represent services clinically related to the episode condition, and if so, which grouping rule should be used to determine their inclusion in an episode. The following discussion describes each of these in further detail; additional specifics can be found in Appendix A.

3.2.1 Organizing Claims into Clinically Meaningful Service Categories

To characterize clinical circumstances more appropriate for review (Step 3 described in Section 3.2 introduction), the claims must first be consolidated into service categories that have a coherent clinical meaning, and thus avoid the unnecessary complexity inherent in Medicare payment schemes for individual setting services. Acumen then segregated outpatient hospital facility (OP) claims into the following clinically meaningful events (service categories): (1) emergency room (ER) visits not resulting in hospitalization, (2) major outpatient procedures (grouped by Ambulatory Payment Classifications or APCs), and (3) the remainder of the OP claims (physician services and minor outpatient procedures) classified into the procedure categories specified in the Clinical Classification Software (CCS) procedure categorization which is maintained by Agency for Healthcare Research and Quality (AHRQ) through its Healthcare Cost and Utilization Project (HCUP); CCS organizes Healthcare Common Procedure Coding System (HCPCS) and CPT-4 procedure codes into 244 mutually-exclusive procedure categories with no hierarchical structure. Acumen segregated OP claims into the CCS procedure categories for clinical review. Within each of these categories, total payments are reported based on the most clinically informative component of the claim type so clinical relevance could be determined.

3.2.2 Identification of Significant Preadmission and Post-Discharge Services by Total Payments

Once combined into clinically relevant aggregations, the empirical analysis step determines the total payments and overall share for each category of service in relation to aggregate spending. The analysis keeps only preadmission and post-discharge services that account for a sufficient share of payments to assess for grouping in the clinical review step (described below). For admissions, emergency room visits, major outpatient procedures, and minor outpatient and physician services, categories were assessed for grouping if they met a threshold of at least 0.5% of total payments within their service category (e.g., DRG families that represented at least 0.5% of total IP hospital payments within the episode window). SNF claims are not categorized for clinical evaluation as they are grouped according to an overall rule based on their linkage to a preceding qualifying IP stay (further described below).

3.2.3 Clinical Review to Select Grouped Services

For the preadmission and post-discharge services that satisfied the payment thresholds, physician reviewers were asked to classify the preadmission and post-discharge services within each of the service categorizations described in Section 3.2.1 (and outlined under Grouping Services in Table 1). The clinical framework for selecting relevant services was provided for clinician reviewers to select related service categories. The clinical events and scenarios to be tailored for each episode condition were suggested as follows:

1. Treatments for the condition;
2. Diagnostic workups and evaluations of the condition;
3. Events related to care, treatment or diagnosis of complications related to the condition (e.g., side effects);
4. Hospital-acquired conditions (e.g., bed sores) and complications of hospitalization (e.g. deep venous thrombosis); and
5. Post-acute care.

For service categories judged clinically relevant, clinicians next determined the best grouping rule for use with each relevant service category according to its clinical context. The set of potential grouping rules that could be selected for each relevant service were:

1. Services grouped based on the category alone (i.e., services that are directly relevant to the episode condition without need for further diagnostic or other information);
2. Services that are grouped if newly occurring in the patient's claims history after the episode begins (i.e., the service did not occur in any Medicare setting in the 90 days prior to the start of the index hospitalization);
3. Services that are grouped only if paired with a relevant diagnosis or procedure code on the same claim;

4. Services that are grouped according to Rule 3 above and where the relevant diagnosis or procedure on the claim is newly apparent in the patient's claims history after the episode begins (i.e., the diagnosis or procedure did not occur in any Medicare setting in the 90 days prior to the start of the index hospitalization).

Additionally, skilled nursing facility (SNF) claims were included when linked, pursuant to Medicare payment policy, to a qualifying IP stay that is grouped to the episode. All IP, home health (HH), and SNF claims (relevant claims extending over 1 day) that begin within the post-discharge episode window were included if they met their clinical logic criteria.

4 CALCULATING THE HOSPITAL-BASED EPISODE MEASURE

The hospital-based episode measure presents the payment-standardized, risk-adjusted episode payments, i.e. hospital average and individual episode payments after controlling for geographic variation in rates paid within Medicare systems and beneficiary case mix. The steps used to calculate risk-adjusted payments align with the National Quality Forum-endorsed MSPB method as specified under current IPPS law, and broadly follow the CMS hierarchical condition categories (CMS-HCC) risk-adjustment, which is derived from Medicare Parts A and B claims. The following discussion describes the calculation of risk-adjusted episode payments for the six hospital-based episodes using the MSPB Measure methodology, described in detail in the *MSPB Measure Information Form* available on QualityNet.[5] Risk adjusted episode payments are calculated according to eight steps. The following sections describe each step in turn.

4.1 Step 1: Standardize Claim Payments

The first step is to eliminate variation in payments due to Medicare geographic adjustment factors to calculate the standardized payment for each claim. The goal of this step is to remove sources of variation not directly related to decisions to provide clinical services. Payment standardization controls for geographic variation in healthcare payments, such as the hospital wage index and geographic practice cost index (GPCI).[6]

4.2 Step 2: Calculate Standardized Episode Payments

Next, to prepare claims data for calculating risk-adjusted payments, standardized episode payments are calculated. For each episode, standardized payments sums all standardized Medicare claims payments for grouped services. As described in previous sections, the MSPB method groups all Medicare claims payments made during the episode window, while the hospital-based episodes group payments only for clinically relevant services during the episode window.

4.3 Step 3: Calculate Predicted Episode Payments

The third step calculates predicted payments for each episode. As in the calculation of predicted payments in the MSPB measure, this step estimates the relationship between the independent variables (age, HCCs, disabled/ESRD enrollment status, long term care indicator, variable interactions, and the MS-DRG of the index hospital admission) and standardized

[5] QualityNet, "MSPB Measure Information Form" (Revised May 2013), https://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1228772057350

[6] QualityNet, "CMS Price Standardization" (Revised May 2013), https://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1228772057350

episode payments using an ordinary least squares (OLS) regression. See Appendix B for a full list of the MSPB independent variables.

The MSPB method estimates the model separately for episodes within each major diagnostic category (MDC), whereas the method to calculate risk adjusted payments for the hospital-based episodes estimates the model within each episode type. Two of the hospital-based episode types, hip replacement and knee replacement, represent conditions that are in the same MDC. Accordingly, the hospital episode-based measures are individually risk-adjusted at the specific episode type level to recognize the distinctions.

4.4 Step 4: Truncate Predicted Values

Next, extreme predicted values are truncated (a.k.a. "bottom coded") and the resultant values are renormalized to maintain a consistent average episode payment. Predicted values are truncated at the 0.5^{th} percentile. In accordance with the MSPB model, renormalization multiplies the truncated predicted values by the ratio of the average original predicted payment and the average truncated predicted payment.

4.5 Step 5: Calculate Residuals

Fifth, the residuals for each episode are calculated as the difference between standardized episode spending Y_{ijk} and truncated predicted spending $\hat{Y}_{ijk}$ for episode i and hospital j for episode type k:

$$Residual_{ijk} = Y_{ijk} - \hat{Y}_{ijk}$$

4.6 Step 6: Exclude Episodes with Outlier Residuals

The sixth step excludes outliers from the calculation and renormalizes the resultant predicted values to maintain a consistent average episode payment level. Episodes with residuals below the 1st percentile or above the 99th percentile of the residual distribution are excluded, reducing the impact of high- and low- payment outliers on a hospital's score. In contrast to MSPB, which combines all episodes from all MDCs before excluding outliers, the method used for the hospital-based episodes excludes outliers at the episode-type level. Predicted values after outlier exclusion are renormalized by multiplying each value by the ratio of the average original predicted payments to the average truncated predicted payments.

4.7 Step 7: Calculate Hospital-Level Risk-Adjusted Payments

The hospital-level risk-adjusted payments are calculated for all hospitals with at least one episode and represents a hospital's per-episode spending level, assuming the hospital's composition of episodes is equal to the national average. It is calculated as the ratio of the average standardized episode payments per hospital over the average predicted episode payments

per hospital multiplied by the average episode payments level for all hospitals. Mathematically, the hospital-level risk-adjusted payments are calculated as:

$$Risk\ Adjusted\ Payments_{jk} = \frac{\frac{1}{n_{jk}}\sum_{i\in\{I_{jk}\}} Y_{ijk}}{\frac{1}{n_{jk}}\sum_{i\in\{I_{jk}\}} \hat{Y}_{ijk}} \left(\frac{1}{n_k}\sum_{i\in\{I_k\}} Y_{ik}\right)$$

where

Y_{ijk} is the standardized payment for episode i at hospital j for episode type k,

$\hat{Y}_{ijk}$ is the payment for episode i at hospital j for episode type k, using the renormalized predicted values from the risk-adjustment regression after Step 6,

Y_{ik} is the standardized payment for episode i for episode type k,

n_{jk} is the number of episodes at hospital j for episode type k,

n_k is the total number of episodes of episode type k,

$i \in \{I_{jk}\}$ indicates all episodes i in the set of episodes attributed to hospital j that are of episode type k,

$i \in \{I_k\}$ indicates all episodes i in the set of episodes that are of episode type k..

4.8 Step 8: Calculate Episode-Level Risk-Adjusted Payments

In addition, episode-level risk-adjusted payments are calculated as:

$$Risk\ Adjusted\ Payments_{ik} = \frac{Y_{ik}}{\hat{Y}_{ik}} \left(\frac{1}{n_k}\sum_{i\in\{I_k\}} Y_{ik}\right)$$

where

Y_{ik} is the standardized payment for episode i for episode type k,

$\hat{Y}_{ik}$ is the payment for episode i for episode type k, using the renormalized predicted values from the risk-adjustment regression after Step 6,

n_k is the total number of episodes of episode type k,

$i \in \{I_k\}$ indicates all episodes i in the set of episodes that are of episode type k.

5 EPISODE ATTRIBUTION

Episodes are attributed to the discharging hospital of the triggered acute inpatient stay. Episodes that involve the transfer of patients between hospitals are excluded from the episode calculations. Thus, all clinically relevant payments in the 3 days pre-admission, during stay, and 30 days post-discharge that are grouped to an episode are attributed to the hospital where the inpatient trigger stay occurred.

6 RESULTS OF PROPOSED EPISODE DEFINITIONS

The hospital-based episode definitions resulting from the process detailed above were applied to the universe of hospitalized Medicare patients in calendar year 2012 to test the measure specifications. The following tables present the distributions of payment-standardized, risk-adjusted payments at the hospital- and episode-level for each of the six hospital-based episodes. Table 3 details the episode-level distributions, and Table 4 presents the hospital-level average distributions.

The episode-level payment distributions are notable for having a positive skew with a long tail at the top of the distribution and the median for all episodes substantially below the mean. Once the episodes are aggregated and averaged at the hospital-level though, this result is mitigated and the mean and median are closely matched with narrower and more symmetric distributions around the median.

Table 3: Distribution of Payment-Standardized, Risk-Adjusted Calendar Year 2012 Medicare Parts A and B Episode Payments

Episode	# of Episodes	Total Payments	Average Payments per Episode	25th Percentile	50th Percentile	75th Percentile	Standard Deviation
Kidney/UTI	234,977	$2,575,557,221	$10,961	$6,008	$7,492	$13,886	$7,421
Cellulitis	143,647	$1,441,246,515	$10,033	$6,347	$7,513	$10,960	$6,325
GI Hemorrhage	181,646	$1,968,514,035	$10,837	$7,769	$8,809	$11,067	$5,647
Hip Replacement/ Revision	120,734	$2,627,495,546	$21,763	$16,537	$19,721	$25,394	$7,232
Knee Replacement/ Revision	233,907	$4,860,562,264	$20,780	$16,755	$19,133	$23,766	$5,570
Spinal Fusion/ Refusion	69,456	$2,659,564,905	$38,291	$31,297	$34,517	$42,353	$10,592

Table 4: Distribution of Payment-Standardized, Risk-Adjusted Calendar Year 2012 Medicare Parts A and B Average Hospital Episode Payments

Episode	# of Hospitals	Total Payments	Average Payments per Hospital per Episode	25th Percentile	50th Percentile	75th Percentile	Standard Deviation
Kidney/UTI	4,483	$2,575,557,221	$10,638	$9,307	$10,677	$11,910	$2,513
Cellulitis	4,433	$1,441,246,515	$10,015	$8,411	$9,736	$10,989	$2,859
GI Hemorrhage	4,180	$1,968,514,035	$10,612	$9,431	$10,477	$11,484	$2,477
Hip Replacement/ Revision	3,086	$2,627,495,546	$22,403	$19,977	$21,951	$24,192	$3,883
Knee Replacement/ Revision	3,283	$4,860,562,264	$21,157	$19,249	$20,802	$22,625	$3,073
Spinal Fusion/ Refusion	1,933	$2,659,564,905	$38,307	$34,991	$37,661	$40,523	$5,516

APPENDIX A – EPISODE SPECIFICATIONS

The following tables present detailed specifications for constructing episodes. Table A-1 provides specifications for grouping claims to episodes. Table A-2 provides definitions of trigger events for each episode type.

Table A-1: Medicare Claim Grouping Specifications

Episode Characteristic	Definition
Trigger Event	Part A acute inpatient hospital discharge on or after December 1, 2011 and on or before November 30, 2012 for medical conditions and surgeries as defined in Table A-2. Trigger events with admission dates before January 4, 2011 are excluded.
Episode Time Window and Three Periods	3 days prior to the trigger event inpatient (IP) admission date through 30 days after the trigger event discharge date. Episodes are divided into three periods: - Preadmission: 3 days preceding IP admission date, - During Stay: IP admission date to discharge date, and - Post-discharge: 30 days after IP discharge date.
Service Categorizations For Assessing Grouping	1. IP claims, aggregated by diagnosis related group (DRG) families. DRG families combine 'w/CC' and 'w/MCC' DRGs into a single DRG family. 2. Outpatient emergency room (ER[7]) claims classified by diagnostic codes on the ER physician claim. 3. Outpatient (OP) claims categorized by ambulatory payment classification (APC). 4. Carrier claims (also known as the Physician/Supplier Part B claims) and all remaining OP services aggregated into Clinical Classification Software (CCS) categories. 5. Durable medical equipment (DME) claims assessed by healthcare common procedure coding system (HCPCS) code. 6. Home health (HH) claims grouped according to 3-digit revenue center code representing HH service type.[8] 7. Skilled nursing facility (SNF) claims based on relation to a Medicare qualifying IP stay.
Service Categorizations Grouped by Episode Period	All Medicare claims that begin within the episode window are considered for inclusion. Claims from the following service categories are grouped within each episode period: <u>Preadmission Period</u>: • Clinically relevant[9] carrier claims, and • Carrier claims with modifier 57 (decision for surgery), for surgical episodes only. <u>During Stay Period</u>: • IP services and carrier claims. <u>Post-Discharge Period</u>: • Clinically relevant IP, ER, OP, carrier claim, DME, HH, and SNF services[10].

[7] OP ER claims are OP claims with a revenue center code in 0450, 0451, 0452, 0456, 0459, 0981.

[8] HH service types are identified by the following six revenue center codes: physical therapy (042x), occupational therapy (043x), speech language pathology (044x), skilled nursing (055x), home health aide (057x), medical social services (056x).

[9] Clinically relevant services are those that either (a) occur during the preadmission and during stay periods and are directly related to treatment of the health event or (b) occur during the post-discharge period and can be affected by the quality of hospital treatments.

[10] Hospice services are not included for the set of episodes currently under consideration because hospice care should not be clinically relevant to these episodes.

Table A-1: Medicare Claim Grouping Specifications (continued)

Episode Characteristic	Definition
Preadmission Period Payment Thresholds	• CCS categories (service category 4) assessed for grouping must represent ≥ 0.5% of carrier claim payments during the preadmission period. • For CCS categories (service category 4) that require diagnostic information, only diagnoses that account for the top 60% of preadmission period carrier claim payments are considered.
Post-discharge Period Payment Thresholds	• For service categories 1-5 above (non-SNF, non-HH), categories assessed for grouping during the episode window must meet a threshold of ≥ 0.5% of post-discharge period payments within the service setting (e.g., DRG families that represent at least 0.5% of total IP hospital payments within the episode window). HH claims are not subject to this restriction. Ambulance claims are not included when calculating payment thresholds. • Additionally, for service categories 1-6 (non-SNF claims), which require diagnostic information on the claim for determining grouping, only diagnoses that account for the top 90% of post-discharge period payments for IP or the top 60% for the other categories are considered. • SNF claims (service category 7) that begin in the post-discharge period are grouped in their entirety when they meet the grouping criteria described below.
Grouping Rules	***Rules for Service Categories 1, 3, 4, 5, and 6 (non-ER, non-SNF):*** • **Rule 1**: Services grouped based on the category alone (i.e., services that are directly relevant to the episode condition without need for further diagnostic or other information). • **Rule 2**: Services that are grouped if newly occurring in the patient's claims history after the episode begins (i.e., the service did not occur in any Medicare setting in the 90 days prior to the start of the index hospitalization). • **Rule 3**: Services that are grouped only if paired with a relevant diagnosis or procedure code on the same claim. • **Rule 4**: Services that are grouped according to Rule 3 above and where the relevant diagnosis or procedure on the claim is newly apparent in the patient's claims history after the episode begins (i.e., the diagnosis did not occur in any Medicare setting in the 90 days prior to the start of the index hospitalization). ***ER Grouping Rule (Service Category 2):*** • **ER:** All OP ER claims with a clinically relevant diagnosis on the ER E&M service are grouped. ***SNF Grouping Rule (Service Category 7):*** • **SNF:** SNF claims are grouped when linked to the IP stay defining the episode condition (e.g., the SNF claim's qualifying IP hospitalization was the kidney/UTI episode trigger event). The qualifying stay thru date on the SNF claim is used to link to the trigger IP stay.
Episode Exclusions	1. Lack of continuous enrollment in Medicare Parts A and B from 90 days prior to IP admission through the end of the episode with Medicare as the primary payer. 2. Death date during episode window. 3. Beneficiaries who enroll in Medicare Advantage during the episode window.
Trigger Claim Exclusions	1. Those with data coding errors including missing date of birth or death dates preceding the date of the trigger event. 2. Claims with payment ≤ 0 or with an unknown DRG code. 3. Acute inpatient stays that involved a transfer. 4. Claims from a non-IPPS or non Subsection (d) hospital.[11]
Overall Claim Exclusions	• Claims with payment ≤ 0.

[11] Non-IPPS hospitals include cancer hospitals, Veterans' hospitals, federal hospitals, emergency hospitals, hospitals in Maryland, and hospitals located outside the 50 states and DC.

Table A-2: Episode Trigger Definitions

Episode	Trigger Definition
Kidney and Urinary Tract Infection	IP hospital discharges with either of the following MS DRGs: - 689. *Kidney and Urinary Tract Infection w/ MCC* - 690. *Kidney and Urinary Tract Infection w/o MCC*
GI Bleed	IP hospital discharges with one of the following MS DRGs: - 377. *GI Hemorrhage w/ MCC* - 378. *GI Hemorrhage w/ CC* - 379. *GI Hemorrhage w/o CC/MCC*
Cellulitis	IP hospital discharges with either of the following MS DRGs: - 602. *Cellulitis w/ MCC* - 603. *Cellulitis w/o CC*
Hip Replacement	IP hospital discharges with one of the following MS DRGs and one of the following ICD-9 procedure codes. <u>MS DRGs</u>: - 469. *Major joint replacement or reattachment of lower extremity w/MCC* - 470. *Major joint replacement or reattachment of lower extremity w/o MCC* *Revision Code*: - 466. *Revision of hip or knee replacement w/MCC* - 467. *Revision of hip or knee replacement w/CC* - 468. *Revision of hip or knee replacement w/o CC/MCC* <u>ICD-9 Procedure Codes</u>: - 81.51. *Total Hip Replacement* - 81.52. *Partial Hip Replacement* - 00.74. *Hip bearing surface, metal-on-polyethylene* - 00.75. *Hip bearing surface, metal-on-metal* - 00.76. *Hip bearing surface, ceramic-on-ceramic* - 00.77. *Hip bearing surface, ceramic-on-polyethylene* - 00.85. *Resurfacing hip, total, acetabulum and femoral head* - 00.86. *Resurfacing hip, partial, femoral head* - 00.87. *Resurfacing hip, partial, acetabulum* *Revision Codes*: - 00.70. *Revision of hip replacement, both acetabular and femoral components* - 00.71. *Revision of hip replacement, acetabular component* - 00.72. *Revision of hip replacement, femoral component* - 00.73. *Revision of hip replacement, acetabular liner and/or femoral head only* - 81.53. *Revision of hip replacement, not otherwise specified* <u>CPT-4 Codes for Exclusions</u>: - 27125. *Hemiarthroplasty, Hip, Partial (Eg, Femoral Stem Prosthesis, Bipolar Arthroplasty)* - 27130. *Arthroplasty, Acetabular And Proximal Femoral Prosthetic* - 27132. *Conversion Of Previous Hip Surgery To Total Hip Arthroplasty, With Or Without Autograft Or Allograft* - *Replacement (Total Hip Arthroplasty), With Or Without Autograft Or Allograft* *Revision Codes*: - 27134. *Revision Of Total Hip Arthroplasty; Both Components, With Or Without Autograft Or Allograft* - 27137. *Revision Of Total Hip Arthroplasty; Acetabular Component Only, With Or Without Autograft Or Allograft* - 27138. *Revision Of Total Hip Arthroplasty; Femoral Component Only, With Or Without Allograft* <u>Exclusions</u>: - Episodes with both the *LT* and the *RT* modifier codes or modifier code 50 on claims

Table A-2: Episode Trigger Definitions (continued)

Episode	Trigger Definition
Hip Replacement	for the above CPT-4 codes within the during stay and post-discharge periods. - Episodes triggered by an inpatient stay with a primary ICD-9-CM diagnosis code that begins with 820.
Knee Replacement	IP hospital discharges with one of the following MS DRGs and one of the following ICD-9 procedure codes: MS DRGs: - 469. *Major joint replacement or reattachment of lower extremity w/MCC* - 470. *Major joint replacement or reattachment of lower extremity w/o MCC* *Revision Code*: - 466. *Revision of hip or knee replacement* - 467. *Revision of hip or knee replacement w/CC* - 468. *Revision of hip or knee replacement w/o CC/MCC* ICD-9 Procedure Code: - 81.54. *Total Knee Replacement* *Revision Codes*: - 81.55. *Revision of knee replacement, not otherwise specified* - 81.59. *Revision of joint replacement of lower extremity, not elsewhere classified* - 00.80. *Revision of knee replacement, total (all components)* - 00.81. *Revision of knee replacement, tibial component* - 00.82. *Revision of knee replacement, femoral component* - 00.83. *Revision of knee replacement, patellar component* - 00.84. *Revision of total knee replacement, tibial insert (liner)* CPT-4 Codes for Exclusions: - 27446. *Arthroplasty, Knee, Condyle And Plateau; Medial Or Lateral Compartment* - 27447. *Arthroplasty, Knee, Condyle And Plateau; Medial And Lateral Compartments With Or Without Patella Resurfacing (Total Knee Arthroplasty)* *Revision Codes*: - 27486. *Revision Of Total Knee Arthroplasty, With Or Without Allograft; 1 Component* - 27487. *Revision Of Total Knee Arthroplasty, With Or Without Allograft; Femoral And Entire Tibial Component* Exclusions: - Episodes with both the *LT* and the *RT* modifier codes or modifier code 50 on claims for the above CPT-4 codes within the during stay and post-discharge periods.
Lumbar Spinal Fusion	IP hospital discharges with one of the following MS DRGs and one of the following ICD-9 procedure codes: MS DRGs: - 453. *Combined anterior/posterior spinal fusion w/MCC* - 454. *Combined anterior/posterior spinal fusion w/CC* - 455. *Combined anterior/posterior spinal fusion w/o CC/MCC* - 456. *Spinal fusion excluding cervical w/ spinal curvature/malignancy/infect or 9+ fusion w/MCC* - 457. *Spinal fusion excluding cervical w/ spinal curvature / malignancy /infect or 9+ fusion w/CC* - 458. *Spinal fusion excluding cervical w/ spinal curvature / malignancy /infect or 9+ fusion w/o CC/MCC* - 459. *Spinal fusion except cervical w/MCC* - 460. *Spinal fusion except cervical w/o MCC* ICD-9 Procedure Codes: - 81.04. *Dorsal and dorsolumbar fusion, anterior technique* - 81.05. *Dorsal and dorsolumbar fusion, posterior technique*

Table A-2: Episode Trigger Definitions (continued)

Episode	Trigger Definition
Lumbar Spinal Fusion	- 81.06. *Lumbar and lumbosacral fusion, anterior technique* - 81.07. *Lumbar and lumbosacral fusion, lateral transverse process technique* - 81.08. *Lumbar and lumbosacral fusion, posterior technique* - 81.34. *Refusion of dorsal and dorsolumbar spine, anterior technique* - 81.35. *Refusion of dorsal and dorsolumbar spine, posterior technique* - 81.36. *Refusion of lumbar and lumbosacral spine, anterior technique* - 81.37. *Refusion of lumbar and lumbosacral spine, lateral transverse process technique* - 81.38. *Refusion of lumbar and lumbosacral spine, posterior technique* <u>CPT-4 Codes for Exclusions</u>: - 22207. *Osteotomy Of Spine, Posterior Or Posterolateral Approach, 3 Columns, 1 Vertebral Segment (Eg, Pedicle/Vertebral Body Subtraction); Lumbar* - 22212. *Osteotomy Of Spine, Posterior Or Posterolateral Approach, 1 Vertebral Segment; Thoracic* - 22214. *Osteotomy Of Spine, Posterior Or Posterolateral Approach, 1 Vertebral Segment; Lumbar* - 22216. *Osteotomy Of Spine, Posterior Or Posterolateral Approach, 1 Vertebral Segment; Each Additional Vertebral Segment (List Separately In Addition To Primary Procedure)* - 22327. *Open Treatment And/Or Reduction Of Vertebral Fracture(s) And/ Or Dislocation(s), Posterior Approach, 1 Fractured Vertebra Or Dislocated Segment; Thoracic* - 22533. *Arthrodesis, Lateral Extracavitary Technique, Including Minimal Discectomy To Prepare Interspace (Other Than For Decompression); Lumbar* - 22534. *Arthrodesis, Lateral Extracavitary Technique, Including Minimal Discectomy To Prepare Interspace (Other Than For Decompression); Thoracic Or Lumbar, Each Additional Vertebral Segment (List Separately In Addition To Code For Primary Procedure* - 22551. *Arthrodesis, Anterior Interbody, Including Disc Space Preparation, Discectomy, Osteophytectomy And Decompression Of Spinal Cord And/Or Nerve Roots; Cervical Below C2* - 22552. *Arthrodesis, Anterior Interbody, Including Disc Space Preparation, Discectomy, Osteophytectomy And Decompression Of Spinal Cord And/Or Nerve Roots; Cervical Below C2, Each Additional Interspace* - 22556. *Arthrodesis, Anterior Interbody Technique, Including Minimal Discectomy To Prepare Interspace (Other Than For Decompression); Thoracic* - 22558. *Arthrodesis, Anterior Interbody Technique, Including Minimal Discectomy To Prepare Interspace (Other Than For Decompression); Lumbar* - 22585. *Arthrodesis, Anterior Interbody Technique, Including Minimal Discectomy To Prepare Interspace (Other Than For Decompression); Each Additional Interspace* - 22600. *Arthrodesis, Posterior Or Posterolateral Technique, Single Level; Cervical Below C2 Segment* - 22610. *Arthrodesis, Posterior Or Posterolateral Technique, Single Level; Thoracic (With Lateral Transverse Technique, When Performed)* - 22612. *Arthrodesis, Posterior Or Posterolateral Technique, Single Level; Lumbar*

Table A-2: Episode Trigger Definitions (continued)

Episode	Trigger Definition
Lumbar Spinal Fusion	*(With Lateral Transverse Technique, When Performed)* - 22614. *Arthrodesis, Posterior Or Posterolateral Technique, Single Level; Each Additional Vertebral Segment* - 22630. *Arthrodesis, Posterior Interbody Technique, Including Laminectomy And/Or Discectomy To Prepare Interspace (Other Than For Decompression), Single Interspace; Lumbar* - 22632. *Arthrodesis, Posterior Interbody Technique, Including Laminectomy And/Or Discectomy To Prepare Interspace (Other Than For Decompression), Single Interspace; Each Additional Interspace* - 22633. *Arthrodesis, Combined Posterior Or Posterolateral Technique With Posterior Interbody Technique Including Laminectomy And/ Or Discectomy Sufficient To Prepare Interspace (Other Than For Decompression), Single Interspace And Segment; Lumbar* - 22634. *Arthrodesis, Combined Posterior Or Posterolateral Technique With Posterior Interbody Technique Including Laminectomy And/ Or Discectomy Sufficient To Prepare Interspace (Other Than For Decompression), Single Interspace And Segment* - 22800. *Arthrodesis, Posterior, For Spinal Deformity, With Or Without Cast; Up To 6 Vertebral Segments* - 22802. *Arthrodesis, Posterior, For Spinal Deformity, With Or Without Cast; 7 To 12 Vertebral Segments* - 22804. *Arthrodesis, Posterior, For Spinal Deformity, With Or Without Cast; 13 Or More Vertebral Segments* - 22830. *Exploration Of Spinal Fusion* - 22840. *Posterior Non-Segmental Instrumentation (Eg, Harrington Rod Technique, Pedicle Fixation Across 1 Interspace, Atlantoaxial Transarticular Screw Fixation, Sublaminar Wiring At C1, Facet Screw Fixation)* - 22842. *Posterior Segmental Instrumentation (Eg, Pedicle Fixation, Dual Rods With Multiple Hooks And Sublaminar Wires); 3 To 6 Vertebral Segments* - 22843. *Posterior Segmental Instrumentation (Eg, Pedicle Fixation, Dual Rods With Multiple Hooks And Sublaminar Wires); 7 To 12 Vertebral Segments* - 22844. *Posterior Segmental Instrumentation (Eg, Pedicle Fixation, Dual Rods With Multiple Hooks And Sublaminar Wires); 13 Or More Vertebral Segments* - 22845. *Anterior Instrumentation; 2 To 3 Vertebral Segments* - 22846. *Anterior Instrumentation; 4 To 7 Vertebral Segments* - 22849. *Reinsertion Of Spinal Fixation Device* - 22851. *Application Of Intervertebral Biomechanical Device(s) (Eg, Synthetic Cage(s), Methylmethacrylate) To Vertebral Defect Or Interspace* Exclusions: - Episodes for which all claims for the above CPT-4 codes during the during stay period have modifier code *58*.

APPENDIX B – MSPB RISK ADJUSTMENT VARIABLES

Tables A-3 through A-8 present MSPB's risk-adjustment variables.

Table A-3: Age Variables

Indicator Variable	Description Label
0-34	Age between 0 and 34 years old
35-44	Age between 35 and 44 years old
45-54	Age between 45 and 54 years old
55-59	Age between 55 and 59 years old
60-64	Age between 60 and 64 years old
65-69	Age between 65 and 69 years old (reference category)[12]
70-74	Age between 70 and 74 years old
75-79	Age between 75 and 79 years old
80-84	Age between 80 and 84 years old
85-89	Age between 85 and 89 years old
90-94	Age between 90 and 94 years old
95+	Age greater than or equal to 95 years old

Table A-4: Severity of Illness Measures

Indicator Variable	Description Label
HCC1	HIV/AIDS
HCC2	Septicemia/Shock
HCC5	Opportunistic Infections
HCC7	Metastatic Cancer and Acute Leukemia
HCC8	Lung, Upper Digestive, and Other Severe Cancers
HCC9	Lymphatic, Head and Neck, Brain, and Other Cancers
HCC10	Breast, Prostate, Colorectal, and Other Cancers and Tumors
HCC15	Diabetes with Renal or Peripheral Circulatory Manifestation
HCC16	Diabetes with Neurologic or Other Specified Manifestation
HCC17	Diabetes with Acute Complications
HCC18	Diabetes with Ophthalmologic or Unspecified Manifestation
HCC19	Diabetes without Complication
HCC21	Protein-Calorie Malnutrition
HCC25	End-Stage Liver Disease
HCC26	Cirrhosis of Liver
HCC27	Chronic Hepatitis
HCC31	Intestinal Obstruction/Perforation
HCC32	Pancreatic Disease
HCC33	Inflammatory Bowel Disease
HCC37	Bone/Joint/Muscle Infections/Necrosis
HCC38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease
HCC44	Severe Hematological Disorders
HCC45	Disorders of Immunity
HCC51	Drug/Alcohol Psychosis
HCC52	Drug/Alcohol Dependence
HCC54	Schizophrenia
HCC55	Major Depressive, Bipolar, and Paranoid Disorders
HCC67	Quadriplegia, Other Extensive Paralysis

[12] To prevent collinearity in the case of mutually exclusive, exhaustive categorical variables when an intercept term is present, the 65-69 age indicator variable is omitted from the regression.

Table A-4: Severity of Illness Measures (continued)

Indicator Variable	Description Label
HCC68	Paraplegia
HCC69	Spinal Cord Disorders/Injuries
HCC70	Muscular Dystrophy
HCC71	Polyneuropathy
HCC72	Multiple Sclerosis
HCC73	Parkinson's and Huntington's Diseases
HCC74	Seizure Disorders and Convulsions
HCC75	Coma, Brain Compression/Anoxic Damage
HCC77	Respirator Dependence/Tracheostomy Status
HCC78	Respiratory Arrest
HCC79	Cardio-Respiratory Failure and Shock
HCC80	Congestive Heart Failure
HCC81	Acute Myocardial Infarction
HCC82	Unstable Angina and Other Acute Ischemic Heart Disease
HCC83	Angina Pectoris/Old Myocardial Infraction
HCC92	Specified Heart Arrhythmias
HCC95	Cerebral Hemorrhage
HCC96	Ischemic or Unspecified Stroke
HCC100	Hemiplegia/Hemiparesis
HCC101	Cerebral Palsy and Other Paralytic Syndromes
HCC104	Vascular Disease with Complications
HCC105	Vascular Disease
HCC107	Cystic Fibrosis
HCC108	Chronic Obstructive Pulmonary Disease
HCC111	Aspiration and Specified Bacterial Pneumonias
HCC112	Pneumococcal Pneumonia, Empyema, Lung Abscess
HCC119	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage
HCC130	Dialysis Status
HCC131	Renal Failure
HCC132	Nephritis
HCC148	Decubitus Ulcer of Skin
HCC149	Chronic Ulcer of Skin, Except Decubitus
HCC150	Extensive Third-Degree Burns
HCC154	Severe Head Injury
HCC155	Major Head Injury
HCC157	Vertebral Fractures without Spinal Cord Injury
HCC158	Hip Fracture/Dislocation
HCC161	Traumatic Amputations
HCC164	Major Complications of Medical Care and Trauma
HCC174	Major Organ Transplant Status
HCC176	Artificial Openings for Feeding or Elimination
HCC177	Amputation Status, Lower Limb/Amputation Complications

Table A-5: Enrollment Status Variables

Indicator Variable	Description Label
DISABLED	Originally Disabled.
ESRD	End-Stage Renal Disease

Table A-6: Long-Term Care Variables

Indicator Variable	Description Label
LTC	Long-Term Care

Table A-7: Variable Interaction Terms

Indicator Variable	Description Label
HCCs 15-19_HCC80	Diabetes Mellitus*Congestive Heart Failure
HCCs 15-19_HCCs 95-96, 100-101	Diabetes Mellitus*Cerebrovascular Disease
HCC80_HCCs 108	Congestive Heart Failure*Chronic Obstructive Pulmonary Disease
HCC108_HCCs 95-96, 100-101_HCCs 81-83	Chronic Obstructive Pulmonary Disease*Cerebrovascular Disease*Coronary Artery Disease
HCC131_HCC80	Renal Failure*Congestive Heart Failure
HCC131_HCC80_HCCs 15-19	Renal Failure*Congestive Heart Failure*Diabetes Mellitus
DISABLED_HCC5	Disabled, Opportunistic Infections
DISABLED_HCC44	Disabled, Severe Hematological Disorders
DISABLED_HCC51	Disabled, Drug/Alcohol Psychosis
DISABLED_HCC52	Disabled, Drug/Alcohol Dependence
DISABLED_HCC107	Disabled, Cystic Fibrosis

Table A-8: Indicator Variable

Indicator Variable	Description Label
MS-DRGs	For a complete list of all MS-DRGs, see: https://www.cms.gov/acuteinpatientpps/downloads/FY_12_NPRM_Table_5.zip on QualityNet

APPENDIX C – NON-CMS PHYSICIAN REVIEWERS

In this preliminary stage of hospital-based episode creation, Acumen consulted three non-CMS physician experts to conduct clinical decision making during the episode selection and construction process. CMS physicians were involved during the episode development process. Biographical information for each of the non-CMS physicians is listed below.

Dr. Ashwini Davison:

Dr. Davison has a background in disease management, quality improvement, and medical informatics. She is a part-time instructor in the Division of Geriatric Medicine and Gerontology at Johns Hopkins University. Dr. Davison received a B.A. in Psychology from Stanford University and an MD from UCLA. She trained in Internal Medicine at Johns Hopkins and is currently a board certified internist, licensed in the state of Maryland.

Dr. Daniella Perlroth:

Dr. Perlroth is a physician employed on this project by Acumen, LLC with a background in management and health care consulting, medical informatics and analysis of claims data. She received her M.D. from Stanford University and completed an internal medicine and infectious diseases fellowship at Stanford Hospital & Clinical prior to a Medical Informatics fellowship with the Stanford Center for Primary Care and Outcomes Research. She is board certified in internal medicine and infectious disease and licensed to practice medicine in the state of California.

Dr. Derek Moore:

Dr. Moore is a practicing orthopaedic spine surgeon and the founder of the educational website Orthobullets.com. He graduated from the University of California, Berkeley, where he studied Biochemistry and Molecular Biology and published on his research on the molecular epidemiology of HIV-1. He graduated from Stanford Medical School, where his research focused on applying new technology to medical education. Following medical school, he worked as a consultant for The Boston Consulting Group for two years before returning to complete his residency in orthopaedics at Columbia University Medical Center, and his fellowship in spine surgery at the Hospital for Special Surgery. He currently shares his time between his clinical practice in Dartmouth, MA, and educational development activities for the Orthobullets.com website. He has a strong interest in resident advocacy and medical education curricula.