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Research and Education Foundation

Episode-based Resource Use Measures

Episode-of-Care for Community-Acquired Pneumonia Hospitalization

This measure was developed by the American Board of Medical Specialties Research and Education Foundation for the High Value Health Care Project: Characterizing Episodes and Costs of Care—funded by the Robert Wood Johnson Foundation under grant 63609.

The Episode-based Resource Use Measures (Measures) and related data specifications, developed by the American Board of Medical Specialties Research and Education Foundation (ABMS REF), are intended to facilitate quality improvement activities by physicians.

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Pneumonia Measure Workgroup Members

William Dalsey, MD
Erika Ernst, MD
Thomas File, MD
Lawrence Goodman, MD
Elizabeth Marlow, MD
Mark Metersky, MD
Michael O'Dell, MD
Vincent Quagliarello, MD

Episode-based Resource Use Measures Project Staff

Kevin Weiss, MD
Niall Brennan
Iris Chan
Katie Harrell
Raymond Kang
Todd Lee, PharmD, PhD
Christopher Lyttle
Larry Manheim, PhD
Sophie C. Shen
Kevin Stroupe, PhD
Robin Wagner
Adam Wilk
Mark Zezza, PhD

Episode-of-Care for Community-Acquired Pneumonia Hospitalization

Measure Description

Resource use and costs associated with management of adult episode following initial admission for community acquired pneumonia (CAP). The episode is defined to last 30 days from the day of admission to the hospital, and will also include the 3 days prior to hospital admission and will measure all pneumonia-related resource use. Attribution will occur at the level of the admitting hospital.

Required Data Elements

Administrative claims data

Calculation

For patients meeting the inclusion criteria, determine pneumonia-related resource use and costs during the episode. A standard price list will be applied to estimate the costs of the episode of care related to pneumonia. Hospital inpatient costs are based on per diem cost for a DRG and will be multiplied by length of stay for the event.

Episode Definition

Pneumonia-related care for 30 days following hospital admission and the 3 days prior to admission. The triggering event is a hospital admission with either pneumonia as the primary diagnosis or as secondary with the following primary diagnoses: septicemia, respiratory failure, bacteremia, and empyema.

Rationale

The Institute of Medicine and AQA (formerly known as the Ambulatory Care Quality Alliance) have identified pneumonia as one of 20 conditions that should be considered priority areas in need of quality improvement based on its relevance to a significant volume of patients, its impact on those patients, and the perception of opportunity to significantly improve the quality and efficiency of related care. There are estimates of up to 5 to 6 million cases of community acquired pneumonia (CAP) diagnosed annually in the United States, accounting for approximately 1 million hospitalizations and approximately 10 million physician visits. It is estimated that the annual cost of treating CAP in the United States is \$12.2 billion.¹ Pneumonia is the second most common reason for hospitalization after childbirth.²

1 G. Colice et al. Treatment Costs of Community-Acquired Pneumonia in an Employed Population. *Chest* 2004; 125: 2140-2145.

² "Pneumonia Most Common Reason for Hospitalization." AHRQ. <http://www.ahrq.gov/news/nn/nn070208.htm>.

Major decisions regarding management of CAP revolve around the initial assessment of severity, which will help determine whether hospitalization is necessary and the level of resources used.³ CAP hospitalization episodes considered here include episodes initiated by an ambulatory care visit if there is a hospitalization within three days after that visit. Absent such a hospitalization, the episode will be potentially classified as a pneumonia ambulatory care episode. Individuals with prior hospitalizations within 90 days (>2 days LOS or pneumonia diagnosis with any LOS) or NH residence are excluded to eliminate hospital/institution-acquired pneumonias. Individuals with E&M visit for pneumonia between 4 days and 6 weeks prior to trigger admission are excluded.

The CAP hospital episode will be attributed at the hospital level, in part, due to the inaccuracy of defining the appropriate admitting or managing physician using administrative claims data.

Resource Use Measure

Pneumonia-related resource use/costs

1. Inpatient Facility
2. Evaluation and Management
3. Procedures
4. Imaging
5. Tests
6. DME
7. Pharmacy
8. OP Facility Costs
9. Exceptions/Unclassified
10. Other Services

Eligible Population

Enrollment Criteria	Continuous medical and pharmacy benefit enrollment for two years with no more than one gap in enrollment of more than 45 days during each year of the continuous enrollment.
Age	Patients at least 18 years of age or older during the identification year.
Inclusion Criteria	Occurrence of one of the diagnostic codes in Table CAP-A for a hospital admission during the identification

³ L.Madel et al. Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. CID 2007; 44: S27-72.

period.

Exclusion

Patients are excluded if they are:

Discharged from a hospital after greater than 2 day stay for any reason within 90 days prior to trigger inpatient admission or discharged from hospital within 90 days prior to trigger admission (any LOS) with a CAP primary diagnosis (see **Table CAP-C1**).

Identified as resident of a nursing home or a hospice patient during the six months prior to the trigger admission (see **Table CAP-C1**).

Persons with an ambulatory E&M claim with pneumonia diagnosis (see **Tables CAP-C2 and CAP-C3**) between 4 days and 6 weeks prior to admission.

Persons with active cancer during measurement or prior period (see **Table CAP-C4**).

Persons with end stage renal disease during measurement or prior period (see **Table CAP-C5**).

Persons with organ transplant during measurement or prior period (see **Table CAP-C6**).

Persons with HIV-AIDS diagnosis during measurement or prior period (see **Table CAP-C7**).

Persons with lung cancer or cystic fibrosis diagnosis during measurement or prior period (see **Table CAP-C8**).

Table CAP-A: Diagnostic Codes to identify CAP Related Hospital Admissions for inclusion in CAP Hospitalization Episodes (Primary diagnoses except where noted).

Description	ICD-9 Code
Viral pneumonia	480.xx
Pneumococcal pneumonia	481.xx
Other bacterial pneumonia	482.xx
Pneumonia due to mycoplasma pneumoniae	483.0
Pneumococcal pneumonia	483.1
Other bacterial pneumonia	483.8
Bronchopneumonia, organism unspecified	485.xx
Pneumonia, organism unspecified	486.xx
Influenza w. pneumonia	487.0
Ornithosis with pneumonia	073.0
Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia)	041.3
Pneumonia codes (see above) used as secondary diagnosis with primary diagnosis of :	
Bacteremia	790.7
Empyema	510.xx
Unspecified pleural effusion	511.9
Septicemia	038.xx
Respiratory failure	518.81, 518.84

Tables CAP-B: Codes Used to Identify Services/Costs to be Included During Episode:

Table CAP-BI: Diagnostic codes to identify clinically relevant ambulatory care services/costs to be included in the CAP Pneumonia episode. (These codes can be primary or secondary diagnoses.)

Description	ICD-9 Codes
Viral pneumonia	480.xx
Pneumococcal pneumonia	481.xx
Other bacterial pneumonia	482.xx
Pneumonia due to mycoplasma pneumoniae	483.0
Pneumococcal pneumonia	483.1
Other bacterial pneumonia	483.8
Bronchopneumonia, organism unspecified	485.xx
Pneumonia, organism unspecified	486.xx
Influenza w. pneumonia	487.0
Ornithosis with pneumonia	073.0
Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia)	041.3
Chest pain	786.50
Fever	780.6

Episode-based Resource Use Measures: CAP Hospitalization

<i>Respiratory-related</i>	
Asthma, unspec.	493.90
Status Asthmaticus	493.91
Asthma unspec. w/ acute exacerbation	493.92
Bronchitis, acute	466.0
Cough	786.2
Influenza, NOS	487.1
Upper respiratory infection, unspec. Site	465.9
Shortness of breath	786.05
Respiratory disease, unspec.	519.9
Wheezing (excludes asthma)	786.07
Pleurisy	511.xx
Costochondritis	733.6
Clostridium-difficile	008.45

Table CAP-B2: CPT Codes to identify services to be included in CAP Hospitalization Episode resource costs regardless of whether there is a pneumonia-associated diagnosis.

Description	CPT Codes
X-Rays chest	71010-71035
CT Chest	71250, 71260, 71270
EKGs	93000, 93005, 93010, 93040, 93041, 93042
Bronchoscopy	31624, 31628
Inhalation Treatment	94640
Decortization, pulmonary	32220
Anesthesia-related procedures	00541, 00520
Blood Count (CBC)	85025
Bronchodilation, spirometry	94010, 94060
Non-invasive ear or pulse oximetry	94760
Carbon-Monoxide diffusing capacity	94720

Table CAP-B3 (Identical to Table CAP-A): Diagnostic Codes to identify CAP Related Hospital Admissions for inclusion in CAP Hospitalization Episodes (Primary diagnoses except where noted).

Description	ICD-9 Code
Viral pneumonia	480.xx
Pneumococcal pneumonia	481.xx
Other bacterial pneumonia	482.xx
Pneumonia due to mycoplasma pneumoniae	483.0
Pneumococcal pneumonia	483.1
Other bacterial pneumonia	483.8
Bronchopneumonia, organism unspecified	485.xx
Pneumonia, organism unspecified	486.xx
Influenza w. pneumonia	487.0
Ornithosis with pneumonia	073.0
Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia)	041.3
Pneumonia codes (see above) used as secondary diagnosis with primary diagnosis of :	
Bacteremia	790.7
Empyema	510.xx
Unspecified pleural effusion	511.9
Septicemia	038.xx
Respiratory failure	518.81, 518.84

Table CAP-B4: Pharmacy: Medications to Include in CAP Hospitalization Episode Resource Use/Costs

Medications
Respiratory agents
Bronchodilators
Antibiotics
Anti-influenza meds (not antiretrovirals)
Steroids – all
O2
Antihistamines
Cough medicines
Nebulizers
Anti-fungals

Do not include valacyclovir

Tables CAP-C: Episode Exclusions

Table CAP-C1: Exclusion Due to Possibility of Hospital-Acquired Pneumonia or Nursing Home-acquired Pneumonia or Treatment in Hospice Program

Hospitalization within 90 days prior to trigger admission for a pneumonia admission (as defined in Table CAP-A).

Hospitalization within 90 days prior to trigger hospitalization, for any reason, if LOS > 2 days.

Residence in nursing home within six months prior to trigger event (determined by medical visit in nursing home or presence of nursing home claim during the six month period).

In hospice program within six months prior to trigger event (determined by presence of hospice claim during the six month period).

Table CAP-C2: Diagnostic Codes to define ambulatory E&M Visit for Pneumonia in prior six weeks (Primary diagnoses).

Description	ICD-9 Code
Viral pneumonia	480.xx
Pneumococcal pneumonia	481.xx
Other bacterial pneumonia	482.xx
Pneumonia due to mycoplasma pneumoniae	483.0
Pneumococcal pneumonia	483.1
Other bacterial pneumonia	483.8
Bronchopneumonia, organism unspecified	485.xx
Pneumonia, organism unspecified	486.xx
Influenza w. pneumonia	487.0
Ornithosis with pneumonia	073.0
Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia)	041.3

Table CAP-C3: Evaluation and Management Codes

Description	CPT Codes
Office or Other Outpatient Services	99201–99215
Hospital Observation Services	99217–99220
Hospital Inpatient Services	99221–99239
Consultations	99241–99275
Critical Care and Intensive Care Services	99289–99298
Nursing Facility, Domiciliary and Home Services	99301–99350

Case Management Services and Care Plan Oversight Services	99361–99380
Preventive Medicine Services	99381–99429
Other E&M Services	99450–99456, 99354–99357

Table CAP-C4: Codes to Identify Active Cancer Treatment

Description	ICD-9-CM Diagnosis
Cancer	140-171; 174-184; 187-203; 204.0; 204.2; 204.8; 205-208; 230-239

WITH

Description	CPT	ICD-9-CM Procedure	UB Revenue
Treatment	38230, 38240-38242, 77261-77799, 79000-79999, 96400-96549	41.0, 41.91, 92.2	028x, 033x, 0342, 0344, 0973

Table CAP-C5: Codes to Identify ESRD – Excluded from analysis

Description	CPT	HCPCS	ICD-9-CM Diagnosis	ICD-9-CM Procedure	UB Revenue	UB Type of Bill	POS
ESRD (including renal dialysis)	36145, 36800-36821, 36831-36833, 90919-90921, 90923-90925, 90935, 90937, 90939, 90940, 90945, 90947, 90989, 90993, 90997, 90999, 99512	G0257, G0311- G0319, G0321- G0323, G0325- G0327, G0392, G0393, S9339	585.5, 585.6, V42.0, V45.1, V56	38.95, 39.27, 39.42, 39.43, 39.53, 39.93, 39.94, 39.95, 54.98	080x, 082x-085x, 088x	72x	65

Table CAP-C6: Codes to Identify Organ Transplant – Excluded from analysis

Description	CPT	HCPCS	ICD-9-CM Procedure	UB Revenue
Organ transplant	32850-32856, 33930-33945, 44132-44137, 44715-44721, 47133-47147, 48160, 48550-48556, 50300-50380	S2152, S2053-S2055, S2060, S2061, S2065	33.5, 33.6, 37.5, 41.94, 46.97, 50.5, 52.8, 55.6	0362, 0367, 0810-0813, 0819

Table CAP-C7: Codes to Identify HIV-AIDS

Description	ICD-9-CM Diagnosis
HIV	042

Table CAP-C8: Codes to Identify Cystic Fibrosis and Lung Cancer

Description	ICD-9-CM Diagnosis
CF	277.0x
Lung Cancer	162.x

Risk Adjustment Method

Comorbid conditions indentified as HCCs in months preceding event date using inpatient and outpatient ICD-9 codes.

Episode Severity / Disease Staging

None

Outlier Methodology

All individuals are included in the analysis with costs winsorized at the 2nd and 98th percentile.

Level of Measurement/Analysis

Measurement will take place at the level of hospital. Attribution of resource use and costs for a patient will be assigned to the hospital at which the admission occurs.

Technical Appendix

Episode-of-Care for Community-Acquired Pneumonia Hospitalization

Appendix Overview

The following document provides step-by-step methods for implementing the Episode-of-Care for Patients with Community-Acquired Pneumonia Hospitalization measure using an administrative, claims, or healthcare encounter database.

There are 9 sections for calculating person-level episode costs:

1. Eligible population identification
2. Identification of related resources
3. Assignment of standardized prices
4. Create episode specific strata
5. Calculation of individual episode costs
6. Calculation of risk-adjusted costs
7. Determination of attributable provider
8. Creation of provider summaries
9. Reporting

Measure Description

Resource use and costs associated with management of adult episode following initial hospital admission for community acquired pneumonia (CAP). Episode is defined to last 30 days from the date of admission to the hospital, and will also include the 3 days prior to admission. Episode related resource use during the measurement period for patients with CAP is identified and standardized costs are applied. Pneumonia costs per patient are attributed at the hospital level. Observed costs are compared to risk-adjusted expected costs at the hospital level.

Required Data Elements

Eligibility and/or enrollment information (both medical and pharmacy)

Administrative claims:

- Inpatient
- Outpatient
- Pharmacy

Required Data Duration and Timeframe

A minimum of 24 months of continuous data is necessary to calculate the measure. An episode is defined by a trigger event observed over an 11 month identification year. In addition, a utilization period of 12 months prior to the trigger event is necessary to exclude individuals based on certain criteria. Finally, the measurement period is 30 days subsequent to the trigger event, which is required to collect episode-related utilization.

Note that the identification year is a fixed 11-month period, while the prior year and the measurement period are both defined relative to the trigger event. Thus, if trigger events occur on the first and last days of the identification period, 12 additional months of data prior to the identification period and 30 additional days subsequent to the identification year are needed. The identification period is defined as 11 months rather than one year to limit the total data needed to two years.

Definitions

Prior year	12-month period prior to trigger event used to exclude people
Identification year	Fixed 11 month period used to define a trigger event.
Measurement period	One year period over which CAP hospitalization-related resource use is measured; for each individual it includes 30 days following trigger event.
Measure population	The collection of patients who meet all measure inclusion criteria and do not meet any measure exclusion criteria. Their resource use will be calculated and included in provider summary reports.
Age	Patient age during the identification or measurement year will be defined as the patient's age at the first day of the identification period.
CAP Pneumonia Hospitalization-related¹	Healthcare encounters defined as being related to CAP Hospitalization and post-hospitalization care and well as ambulatory care during the three days prior to admission.
Continuous enrollment	As identified in eligibility or enrollment information, full medical and pharmacy benefit enrollment during both the measurement period and the prior year.

¹ May refer to services both appropriately and inappropriately rendered in the treatment or management of an pneumonia patient

Medication dispensing event Medication dispensing with a positive, non-zero cost.

Inpatient Hospital Event An acute care overnight hospital stay of ≥ 1 day with positive associated charges

Section I – Eligible Population Identification

The process of identifying patients to be included in the measure is divided into three separate steps, each with multiple sub-steps. The following steps are used for identifying the included population:

Step 1: Identify patients that meet the episode definition inclusion criteria

Step 2: Identify patients that meet eligibility and continuous enrollment criteria

Step 3: Identify patients with exclusion criteria

Step 4: Combine prior steps to identify measure population

Step 1: Identify patients that meet episode inclusion criteria

1. Identify patients that have one of the diagnostic codes in **Table CAP-A** for a CAP Hospital admission during the event identification period.

Step 2: Identify patients that meet age, eligibility and continuous enrollment criteria

1. Age: Identify patients aged 18 and older.
2. Eligibility
 - a. Identify benefits during both the measurement period and prior period.
 - b. To be included persons must have both of the following benefits in both periods
 - i. Medical benefit
 - ii. Pharmacy benefit
3. Continuous enrollment
 - a. Determine enrollment during both the measurement and prior periods.
 - b. To be eligible, persons must have medical and pharmacy coverage for the measurement period and prior period.

Step 3: Identify patients with exclusion criteria

1. Identify patients that meet one or more exclusion criteria during either the measurement period OR the prior year
2. Exclusion criteria :
 - Patient had ambulatory care diagnosis (see **Table CAP-C2**) for E&M ambulatory visit (see **Table CAP-C3**) between 4 days and 6 weeks prior to potential trigger ambulatory pneumonia visit.
 - Discharged from hospital after greater than 2-day stay for any reason within 90 days prior to trigger E&M visit or discharged within 90 days prior to trigger E&M (any LOS) with a CAP primary diagnosis (see **Table CAP-CI**).
 - Residence in nursing home within six months prior to trigger hospitalization (determined by ambulatory medical visit or nursing home claim at any time during six months prior to trigger admission – see **Table CAP-CI**).
 - Hospice care during six months prior to trigger admission (determined by hospice claim any time during six month prior period – see **Table CAP-CI**).
 - Active cancer treatment during measurement or prior period (see **Table CAP-C4**).
 - End stage renal disease (ESRD) during measurement or prior period (see **Table CAP-C5**).
 - Organ transplant during measurement or prior period (see **Table CAP-C6**).
 - HIV/AIDS during measurement or prior period (see **Table CAP-C7**).
 - Cystic fibrosis during measurement period or prior period (see **Table CAP-C8**).
 - Lung cancer during measurement or prior period (see **Table CAP-C8**).

Step 4: Combine prior steps to identify measure population

1. Identify CAP Hospitalization eligible population
2. Exclude those patients not meeting general inclusion criteria (e.g. age, continuous eligibility)
3. Exclude those patients meeting one or more measure exclusion criteria
4. The resulting collection of patients is the measure population

Section 2 – Eligible Event Identification

For each individual in the measure population, identify the CAP hospitalization-related claims for services rendered during the measurement period. Claims / encounters will be identified based on the presence of CAP hospitalization-related diagnosis codes or procedure codes. These events will be used to determine the CAP hospitalization-related resource use.

Inpatient hospitalization events

Identify all inpatient claims/ encounters with a CAP hospitalization-related diagnosis code appearing in the primary diagnosis field except where noted (see **Table CAP-B3**).

Outpatient events

Identify all outpatient claims / encounters with a CAP hospitalization-related diagnostic code appearing in *any* position (see **Tables CAP-B1 and CAP-B2**).

Prescription drugs

Identify CAP hospitalization-related medications by therapeutic class or generic/brand medication name during the measurement period (see **Table CAP-B4**).

Section 3 – Assignment of standardized prices

Standardized prices are calculated for all of the components of care used to treat or manage the patient's condition to ensure that comparisons can be made solely on the basis of differential practice patterns and resource use. Three separate methodologies are used to derive these standardized prices: for inpatient facility charges, for ambulatory pharmacy charges (i.e., prescriptions dispensed outside the inpatient hospital setting), and for all other charges. These standardized prices are then applied to the claims identified as CAP hospitalization-related.

Standard Cost Calculation

Step 1 Identify all claims paid for services rendered during the measurement year and with positive non-zero paid amounts for all patients, regardless as to whether they have been included in the measure population. Categorize these claims as follows (in accordance with the BETOS classification process, modified to allow for separate categories for chiropractic and physical surgery procedure codes:

- *Inpatient Facility* (services provided by a facility during an acute inpatient hospital stay, standard price includes room and board and ancillary services)
- *Ambulatory Pharmacy* (ambulatory prescriptions included in a member's pharmacy benefit)
- *All other* (E&M, chiropractic-specific codes, physical therapy-specific codes, procedures, imaging, tests, DME, other, and exceptions/unclassified)

Step 2 For each category identified, compute standardized prices. Refer to each service category's instructions (i.e., *Calculating Standard Units of Service and*

Total Standard Cost) below.

- Step 3** Combine standardized prices with eligible events (e.g., through a file merge as specified in each service category’s instructions).
- Step 4** For each individual claim, multiple standardized price by the number of service units identified on the claim to determine the full cost of the service, hospitalization, or prescription.

Calculating Standard Units of Service and Total Standard Cost: *Inpatient Facility*

For inpatient facility costs, standardized prices are developed at the diagnosis-related group (DRG) level and – for those hospitalizations where DRG-level information is unavailable – at the ADSC level. Each is adjusted for length-of-stay (LOS) so as to more closely mirror the payment systems typically applied among commercial health plans. Both approaches use RRU HEDIS standardized daily price tables developed by NCQA. All inpatient facility costs are considered “acute” for this analysis.

- Step 1** Identify all inpatient stays that occurred during the measurement year. Include stays that may have started before the measurement year or ended after the close of the measurement year. Define a single, unique record describing the member’s inpatient stay.
- Step 2.** Identify the primary discharge DRG. Also identify the DRG version (e.g., CMS-DRG vs. MS-DRG). Care must be taken in using the standardized price tables (specified below) to insure the data and the tables use the same DRG version.
- Step 3** Compute the stay’s total LOS in days, using paid or expected-to-be-paid days only. Include all paid days in the LOS calculation, whether or not they fall outside the measurement year. Also identify the stay’s LOS group based on the stay’s LOS and the information contained in table below.

Length of Stay Group

LOS (Days)	LOS GRP
1	A
2	B
3-4	C
5-6	D
7-8	E
9-15	F
16 or more	G

- Step 4** Compute the LOS per diem multiplier. If the inpatient stay falls completely within the measurement year, use the total number of paid days as the per diem multiplier. If the inpatient stay does not fall completely inside the measurement year, count only the days within the measurement year (including the last day of the year) to compute the per diem multiplier.
- Step 5** Download the HEDIS RRU standardized daily price tables from the NCQA website (www.ncqa.org) for the corresponding measurement years. Note that there is a one year lag in the file and data years (i.e. files designated 2007 are based on 2006 data). Some years may have two sets of tables if there is a significant change in DRG versions.²
- Step 6** Calculate the DRG-specific per-diem payment rate by adjusting the standard daily prices for inflation to a reference year using the Consumer Price Index (CPI).
- Step 7** Combine DRG-specific per-diem payment rates with the dataset containing eligible inpatient hospital events for the measure. For each event, multiply the per-diem payment rate by the event's LOS per diem multiplier to determine the event's total standard cost.

Total standard costs will not be computed using this approach for stays that have not been assigned a DRG, and for DRGs that are not assigned a standard price by HEDIS. These stays will be assigned a standard price using the ADSC method described below.

Example³ Assume the calculated DRG-specific per-diem payment rate for DRG XXX for FY 2007 is \$900.17. An eligible member had an inpatient stay with the following characteristics:

- A principal diagnosis of XXX.X (eligible event)
- A DRG of XXX
- Date of admission of February 2, 2007 and date of discharge of February 9, 2007 (fiscal year 2007)
- A LOS of 8 days, and therefore a LOS per diem multiplier of 8 days

This event has a calculated total standard cost of $\$900.17 \times 8 = \$7,201.36$.

Example Again assume the calculated DRG-specific per-diem payment rate for DRG XXX for FY 2007 is \$900.17. An eligible member had an inpatient stay with the following characteristics:

- A principal diagnosis of XXX.X (eligible event)
- A DRG of XXX
- Date of admission of December 28, 2006 and date of discharge of January

² The project staff worked in collaboration with NCQA in development of this methodology for purposes of testing the initial set of measures. Users of the measures may need to implement their own methodology that does not rely on a price list from NCQA.

³ Figures presented in this example are arbitrary and do not reflect any particular dataset or patient.

2, 2007 (fiscal year 2007)

- A LOS of 6 days, and a LOS per diem multiplier of 2 days (January 1-2).

This event has a calculated total standard cost of $\$900.17 \times 2 = \$1,800.34$.

- Step 8** If DRG information is not available for a given inpatient hospitalization a method must be used that assigns prices to those hospitalizations. The methodology used in testing the initial development of the measures was to assign an Aggregate Diagnostic Service Category (ADSC) for the stay using the principal discharge diagnosis. To assign ADSC, download the ADSC Table (Table SPT-INP-ADSC) from the NCQA Web site (www.ncqa.org) and match the principal ICD-9-CM Diagnosis code from the discharge claim to an ADSC. If the claim does not contain a DRG and the primary ICD-9-CM Diagnosis code is invalid or missing, map the inpatient stay to the ADSC Table's MISA category.⁴ An alternative would be to create average prices from the dataset the measures are being implemented for each of the ADSC categories and discharge ICD-9-CM codes and assign those prices to missing hospitalizations.
- Step 9** Determine if the member underwent major surgery during the inpatient stay. If this information is not available within the dataset, this may be determined using the list of codes included in a table from the NCQA Web site (Maj-Surg Table). Flag eligible members if one procedure code in the Maj-Surg-Table is present from any provider during the time period defined by the admission and discharge dates.
- Step 10** Match each ADSC, LOS per diem multiplier, and major surgery flag assignment for the stay to a value in the Table SPT-INP-ADSC to obtain the assigned standard price. For each event, multiply the per-diem payment rate by the event's LOS per diem multiplier to determine the event's total standard cost. As with the DRG method, the ADSC standard prices must be adjusted for inflation to a reference year using the CPI. Between this ADSC methodology and the previously described DRG-based methodology, each inpatient hospital stay should now have an associated standardized price.

Example An eligible member had an inpatient stay with the following characteristics:

- A principal diagnosis of XXX.X (eligible event)
- No available valid DRG information
- Date of admission of February 2, 2007 and date of discharge of February 9, 2007
- A LOS of 8 days, and therefore LOS group E
- A major surgery event during the stay

Using Sample Table SPT-INP-ADSC, we determine this event has a standard per-diem

⁴ The project staff worked in collaboration with NCQA in development of this methodology for purposes of testing the initial set of measures. Users of the measures may need to implement their own methodology that does not rely on a price list from NCQA.

payment rate of \$1,474.00. Therefore, this event has a calculated total standard cost of $\$1,474 \times 8 = \$11,792$.

Calculating Standard Units of Service and Total Standard Cost: Ambulatory Pharmacy

For ambulatory pharmacy-related costs, standardized prices are developed at the NDC level, adjusted for days supply.

- Step 1** Identify all pharmacy services that occurred during the measurement year. The following pharmacy services should also be included:
- Prescriptions that may have been dispensed before the measurement year and had days supply that extended into the measurement year (e.g., a prescription with a dispensed date of December 15, 2007 and 30 days supply would extend 13 days into the measurement year beginning January 1, 2008)
 - Prescriptions that may have been dispensed during the measurement year and had days supply that extended into the following year (e.g., a prescription with a dispensed date of December 20, 2008)

Define a single, unique record describing the pharmacy service.

- Step 2** Identify the NDC code and the days supply for each prescription, whether or not some days fall outside the measurement year.
- If the days supply is not available for a given pharmacy claim, set the claim's standard cost to be equal to its listed payment amount.
- Step 3** Compute the days supply per diem multiplier. If the prescription's days supply fall completely within the measurement year, use the claim's listed days supply as the per diem multiplier. If the prescription's days supply do not fall completely inside the measurement year, count only the days within the measurement year (including the last day of the year) to compute the per diem multiplier.
- Step 4** For each NDC, calculate the total NDC-specific payments and the total days supply across all pharmacy claims within that NDC during the measurement year. Using these totals, calculate NDC-specific per-day-supply payment rates by dividing total NDC-specific payments by total days supply for each NDC.
- Step 5** Combine NDC-specific per-day-supply payment rates with the dataset containing eligible pharmacy events for the measure. For each event, multiply the per-day-supply payment rate by the event's days supply per diem multiplier to determine the event's total standard cost.

Calculating Standard Units of Service and Total Standard Cost: All Other

For all non-inpatient hospital, non-pharmacy costs, standardized prices are developed at the procedure code and modifier level.

- Step 1** Identify all non-inpatient hospital, non-pharmacy services that occurred during the measurement year.
- Step 2** Identify the primary procedure code (CPT, HCPCs, ICD-9, etc.) and the first modifier code for each service.
- Step 3** For each procedure-modifier combination, calculate the total procedure/modifier-specific payments across all non-inpatient-hospital, non-pharmacy claims with that procedure-modifier combination as well as the frequency of the procedure-modifier combination during the measurement year. Calculate procedure/modifier-specific payment rates by dividing total procedure/modifier-specific payments by the frequency for each procedure-modifier combination.
- Step 4** Combine procedure/modifier-specific payment rates with the dataset containing eligible non-inpatient-hospital, non-pharmacy events for the measure so that each procedure-modifier combination is paired with its corresponding payment rate. This payment rate is the event's total standard cost.

Section 4 – Create episode specific strata

Not applicable

Section 5 – Calculation of total individual episode costs

The resource use identified as CAP hospitalization-related – and to which standardized prices have been applied (i.e., the collection of eligible events) – is used to calculate individual level episode costs. The following steps are used in the calculation of total individual level costs.

Step 1: For each individual included in the episode, sum all of the total standard costs linked to CAP hospitalization-related events occurring during the measurement year at the adjusted-BETOS level. This will provide an estimate of the costs of each category of service over the measurement period.

Step 2: For each individual in the episode, sum ALL total standard costs linked to CAP hospitalization-related events to calculate TOTAL episode costs.

Section 6 – Calculation of risk adjusted costs

The model developed for comorbidity adjustment uses Hierarchical Condition Categories (HCC) to identify comorbidities. This reflects the risk adjustment methodology used by CMS and recently evaluated by NCQA for their Relative Resource Use (RRU) measures. However, there is an important distinction between the use of HCCs by CMS and the model evaluated by NCQA and the risk adjustment model used to estimate expected costs. The CMS and NCQA model use HCCs to adjust TOTAL costs of care, whereas this model focuses on episode-specific costs of care. Because models developed to adjust total costs of care may not reflect the expected costs for episode-specific resource use, new models were developed from a sample of commercially insured patients for risk adjustment. The following process was completed to develop the models:

1. Utilized quasi-Modified Delphi approach with the condition-specific workgroup to categorize HCCs into three groups:

- Include in risk adjustment model;
- Exclude in risk adjustment model; and
- Test impact in risk adjustment model.

2. Identified HCCs in denominator population during the 12 months preceding the measurement year.

3. Tested 12 different model specifications shown in Table CAP-RAI, where the HCCs included in the model varied, and the distribution and link functions in the generalized linear models also varied. Models were developed in a stepwise manner as indicated. The first four models used a gamma distribution and a log link function. The first model included all HCCs identified by the condition-specific workgroup as “Include HCCs” with a prevalence in the population of $\geq 1\%$. The second model was a reduction of the first model that only included HCCs where $p < 0.1$. The third model extended the second model by including HCCs with prevalence $\geq 1\%$ identified as “Test HCCs” by the condition-specific workgroup. The fourth model was a reduction of the third model and included only those HCCs where $p < 0.1$. The next set of four models (Models 5-8) repeated the process of the first four models but used a normal distribution and identity link function. Model 9 used all of the HCCs, with the exception of the HCC for the episode being evaluated (e.g., asthma for the asthma episode), and a gamma distribution with log link function. Model 10 was a reduction of Model 9 where only the HCCs with $p < 0.1$ were included. The final two models (Models 11-12) used the same process as Models 9 and 10 with a normal distribution and identity link function. For patients with asthma, separate models were generated for each of the age groups included in the episode definition.

Table CAP-RAI. Risk Adjustment Model Specifications

Model #	Independent Variables						Distri- bution	Link function
	WG Specified (> 1%)	WG specified (> 1%) p < 0.1	Test conditions (> 1%)	Test conditions (> 1%) p < 0.1	All HCCs	All HCCs p < 0.1		
1	X						Gamma	Log
2		X					Gamma	Log
3		X	X				Gamma	Log
4		X		X			Gamma	Log
5	X						Normal	Identity
6		X					Normal	Identity
7		X	X				Normal	Identity
8		X		X			Normal	Identity
9					X		Gamma	Log
10						X	Gamma	Log
11					X		Normal	Identity
12						X	Normal	Identity

4. Models were developed in a split sample approach with 75% of the population randomly selected for model development and the remaining 25% used in model evaluation. Model performance was also evaluated in the full cohort.

5. The performance of each model was evaluated through comparisons of the observed and predicted distributions, comparisons of residuals, comparisons of absolute differences between observed and predicted, comparisons of observed-to-predicted ratios, and comparisons of mean squared errors across models. Summary information on model performance was presented to the condition-specific workgroup for selection of a risk adjustment model for the condition. Final model selection was based on the best performing model across metrics. Where model performance was similar, models using the normal distribution were preferentially chosen over the gamma distribution models for ease of implementation. More parsimonious models were also preferentially chosen.

The following is the model selected for estimating adjusted costs in the CAP hospitalization episode.

Adjusted CAP Hospitalization Costs = \$10,121 + (Male*\$508) + (Age*\$61) + (Cardio-Respiratory Failure and Shock*\$3,627) + (Renal Failure*\$0) + (Diabetes with Neurologic or Other Specified Manifestation*\$2,609) + (Septicemia/Shock*\$5,597) + (Protein-Calorie Malnutrition*\$7,972) + (Cirrhosis of Liver*\$4,585) + (Intestinal Obstruction/Perforation*\$4,339) + (Drug/Alcohol Dependence*\$5,149) + (Major Depressive, Bipolar, and Paranoid Disorders*\$1,111) + (Quadriplegia, Other Extensive Paralysis*\$6,941) + (Paraplegia*\$16,445) + (Spinal Cord Disorders/Injuries*\$4,483) + (Muscular Dystrophy*\$7,015) + (Multiple Sclerosis*\$4,202) + (Respiratory Arrest*\$16,713) + (Cerebral Palsy and Other Paralytic Syndromes*\$9,220) + (Chronic Ulcer of Skin, Except Decubitus*\$3,964) + (Severe Head Injury*\$34,528) + (Hip Fracture/Dislocation*(\$6,477))

Measure implementers have two choices when calculating risk adjusted costs. The first is to follow the process specified above to create risk adjustment models that are specific to their population and their dataset. The second option is to follow the below steps and use the above estimates for calculating risk adjusted costs. While the latter is a straightforward calculation, caution is warranted as the risk adjusted equations were derived from a population that may be different from the population to which the measure is being applied.

To estimate risk adjusted costs using the above risk adjustment equations in the measurement population, use the following steps:

Step 1: Identify the presence of HCCs on any claim in the 12 months preceding the measurement year, utilizing both inpatient (primary diagnosis field only) and outpatient encounters (all diagnosis fields).

Step 2: Create a person level file that contains an indicator (yes/no) variable for each of the HCCs. These variables indicate whether or not the patient had evidence of each HCC during the previous 12 months.

Step 3: Calculate an adjustment factor of the average episode costs in the measure population and divide it by the average cost of the test episode (Table CAP-RA2). Apply the inflation factor to the risk adjustment coefficients to account for cost differences between datasets used in development of the risk adjustment models and those used in calculating episode costs.

Table CAP-RA2.

	Average Cost
CAP Hospitalization	\$14,839

Episode	
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Example: To calculate the inflation factor, determine the average episode cost in the population to which the measure is being applied. As an example, the average cost might \$20,000. Calculate the adjustment factor by dividing the costs from the current population by the average costs in Table CAP-RA2. That would result in an adjustment factor of 1.35. The adjustment factor is then applied to the estimated coefficients for the adjusted risk adjustment model.

Adjusted Risk Adjustment Model

Risk and Mean Adjusted CAP Hospitalization Episode Costs= 1.35*Risk Adjusted CAP Hospitalization Episode Costs.

Step 4: Use the equation for the appropriate age group to generate risk adjusted expected costs for each individual in the dataset.

Section 7 – Determination of attributable provider

Resource use and costs are attributed to the hospital of episode trigger admission.

Section 8 – Creation of provider summaries

The provider summaries are a report of the resource use for a hospital compared to other hospitals and all episodes in the dataset. Creation of the hospital summaries uses the summary episode costs combined with the attributable hospital data and the risk adjusted episode costs.

Step 1: Create a dataset that includes the following information: episode ID, total episode cost, attributable hospital ID, and episode expected costs from the risk adjustment model.

Step 2: Calculate the observed-to-expected ratio for each of the episodes by dividing observed costs for the episode by expected (predicted) costs for the episode.

Step 3: Summarize the observed, expected and observed-to-expected ratio for each attributable hospital.

Step 5: Summarize the observed, expected and observed-to-expected ratio for the all of the episodes.

Step 6: For each attributable hospital, determine the proportion of observed-to-expected ratios above the 75% percentile of the peer group and calculate the 95% confidence interval

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Step 7: Create provider summary reports for each attributable hospital in the dataset (See CAP Hospitalization-Provider Summary below for example where a set of peer group hospitals might be identified).

**CAP Hospitalization Episode
Report for Hospital XXX**

	Hospitals	Peer Group Hospitals	National Avg
Episodes	1,384	2,533	11,055
Observed Costs*			
Average	\$ 13,878	\$ 13,125	\$ 13,966
Min	\$ 4,953	\$ 4,953	\$ 4,953
Median	\$ 9,565	\$ 9,312	\$ 9,436
Max	\$ 63,987	\$ 63,987	\$ 63,987
Predicted Costs			
Average	\$ 13,966	\$ 13,862	\$ 13,978
Min	\$ 11,210	\$ 11,210	\$ 6,330
Median	\$ 13,594	\$ 13,594	\$ 13,691
Max	\$ 45,859	\$ 45,859	\$ 61,279
Observed to Expected Ratio			
Average	1.00	0.95	1.00
Min	0.25	0.22	0.15
Median	0.70	0.68	0.69
Max	5.62	5.71	5.71
% ≥ 2.0	9.5%	7.7%	9.8%
% ≥ 2.5	6.4%	5.2%	6.7%
% ≥ 75 th percentile peers	(19.9%, 47.5%)		

Section 9 – Reporting

The following section describes reports of unadjusted episode costs that were used to understand patterns of resource use associated with the episodes. Most of these reports are based on the classifications of related resource use by type-of-service category using the Berenson-Eggers Type of Services (BETOS) classification system. This system can be applied following the steps described below.

Reports by Categories of Service

For each of the claims / encounters identified for the episode's CAP hospitalization-related resource use calculations, BETOS codes will be applied to categorize services. BETOS codes and crosswalks to procedure codes are available through the Centers for Medicare & Medicaid Services website.⁵

Step 1: Obtain BETOS files for the relevant year from the CMS website.

Step 2: Combine adjusted BETOS codes with eligible events (e.g., through a file merge).

Step 3: Categorize data from outpatient pharmacy files as pharmacy-related costs – these claims will not have an adjusted BETOS code to combine with the eligible events data. Similarly, categorize data from inpatient hospital files as inpatient facility-related costs.

Step 4: Categorize adjusted BETOS codes into the 8 specified “major categories”:

1. Evaluation and Management (E&M)
2. Procedures
3. Imaging
4. Tests
5. Durable Medical Equipment (DME)
6. Other
7. Exceptions/Unclassified

These categories (along with categories for inpatient facility costs and pharmacy costs) will be used for reporting overall episode costs.

Step 5: Categorize any/all remaining services without corresponding adjusted BETOS codes as belonging to the Exceptions/Unclassified category.

Step 6: Create summary reports of the distribution of costs for each type of service category for all episodes.

The reports we completed to analyze this episode, relying on BETOS categories, included:

- Summaries of per-episode resource use by type of service, including mean, median, standard deviation and variance, other statistical variables: overall and for each episode stratum
- For each type-of-service category for non-inpatient, non-pharmacy claims, summaries of the 20 CPT and HCPCS codes among CAP hospitalization-related services most commonly appearing in episodes and the 20 CPT and HCPCS codes that account for the largest proportions of the category's costs

⁵ https://www.cms.gov/HCPCSRReleaseCodeSets/20_BETOS.asp

Episode-based Resource Use Measures: CAP Hospitalization

- For each type-of-service category for non-inpatient, non-pharmacy claims, summaries of the 20 CPT and HCPCs codes among non-CAP hospitalization-related services most commonly appearing during the measurement window and the 20 CPT and HCPCs codes that account for the largest proportions of the category's costs
- For inpatient hospitalization events, the 20 DRG codes and primary ICD-9 diagnosis codes most commonly appearing and accounting for the largest proportions of inpatient facility costs: both CAP hospitalization-related and non-CAP hospitalization-related.
- For pharmacy claims, the 20 generic drug names and therapeutic classes most commonly appearing and accounting for the largest proportions of pharmacy costs: both CAP hospitalization-related and non-CAP hospitalization-related.