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Episode-based Resource Use Measures

Episodes-of-Care for 12-week Period of GERD Treatment

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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Episodes-of-Care for 12-week Period of GERD Treatment

Measure Description

Resource use and costs associated with management of gastroesophageal reflux disease (GERD) care over a 12-week period following diagnosis and 8 weeks prior to diagnosis. Patients with diagnoses of GERD during the 6-month period prior to the triggering diagnosis are excluded. Costs of care are attributed to the physician providing the plurality of care for GERD during the measurement period.

Required Data Elements

Administrative claims data

Calculation

For patients meeting inclusion criteria, determine GERD-related resource use and costs over a 12-week period after the diagnosis and over an 8-week period before diagnosis. Prices from a standard price list will be applied to the GERD-related resource use to estimate the costs of the episode of care related to GERD. Resources will be defined for ten categories: 1) inpatient facility; 2) evaluation and management; 3) procedures; 4) imaging; 5) tests; 6) DME; 7) other drugs and services; 8) medications; 9) outpatient facility; and 10) other. For inpatient facility costs, the standard cost is based on a per diem cost for a DRG and will be multiplied by the length of stay for the event. Hospitalizations will be included as GERD related if and only if the primary diagnosis code for the hospitalization is GERD related. For each of the other resource use categories, standardized prices will be assigned to each type of utilization that is defined as GERD related. Episodes with \$0 costs in the measurement period will be excluded.

Episode Definition

GERD-related costs over a 12-week period after diagnosis and an 8-week period before diagnosis.

Rationale – GERD 12-week measure

The Institute of Medicine and AQA (formerly known as Ambulatory Care Quality Alliance) have identified GERD 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. It has been reported that 25 percent of Americans experience reflux on a weekly basis – 95,000 were hospitalized

with acid reflux as a primary diagnosis in 2005¹. Also, the costs of treatment for GERD patients in particular can be very high in some cases and have been rapidly increasing in recent years – as part of this increase, hospitalizations resulting from complications of the condition rose 103 percent between 1998 and 2005.² Furthermore, these costs can vary dramatically from one provider to the next as well as across regions because of variations in practice patterns.

GERD is a condition for which appropriate treatment patterns are fairly well-defined for most patients: after diagnosis, the physician should prescribe a proton-pump inhibitor (PPI) and check back with the patient after 8-12 weeks. This measure observes variation in resource use associated with all GERD-related care during this 12-week period to capture other treatments provided in addition to the PPI regimen. The measure also observes variation in resource use during the 8-week period prior to diagnosis to capture the frequency and cost of studies ordered during the diagnostic process. Resource use for GERD patients beyond this 12-week period is measured separately.

This measure will be attributed at the individual physician level. To the extent this individual physician is responsible for more than 70 percent of the patient's E&M visits, this physician will be the only one attributed the episode. If more than one physician is responsible for at least 30 percent of the patient's E&M care, each of those physicians would be attributed the full costs of the episode. If no physician was responsible for at least 30 percent of the patient's E&M care, then the episode would not be attributed to any physician.

Measures

- GERD- related resource use / costs
 - Inpatient Facility
 - Evaluation and Management
 - Procedures
 - Imaging
 - Tests
 - DME
 - Other drugs and services
 - Pharmacy
 - Outpatient Facility
 - Other
 - Exceptions / Unclassified

¹ "Gut Check for Reflux." Los Angeles Times. October 6, 2008.

² "Hospitalizations over chronic acid reflux soar since 1998, U.S. says." Cleveland Plain Dealer. January 2, 2008.

Eligible Population

Age Age \geq 12 yrs
Enrollment Criteria Continuous medical and pharmacy benefit enrollment for at least one year preceding the measurement year and during the measurement year, with no more than one gap in enrollment of more than 45 days during each year of continuous enrollment.

Inclusion Criteria Patients included in the measure must an ambulatory visit with a diagnosis of heartburn, reflux esophagitis, or esophageal reflux (See Table GERD-A for codes).

Exclusion Patients with diagnoses of heartburn, reflux esophagitis, or esophageal reflux (i.e., GERD trigger diagnoses) during the six months prior to the trigger diagnosis (See Table GERD-F for codes):

or

Patients with any of the following diagnoses in the measurement year or the year prior to measurement (i.e., 12-months before and after the trigger diagnosis) are excluded (see Table GERD-F for codes):

- active cancer; end stage renal disease (ESRD); dialysis; renal failure; organ transplant;
- HIV/AIDS; pregnancy;
- strictures; anemia; end-stage liver disease;
- familial polyposis (colon polyps); GI-bleed;
- abnormal weight loss; aspiration; dysphagia;
- persistent vomiting; vomiting alone; hematemesis;
- gastritis; gall stones;
- ulcer-diseases (e.g., peptic ulcer disease);
- Barrett’s esophagus;
- familial history of GI-tract cancer

Table GERD-A: Codes to identify GERD diagnosis (episode trigger)

Description	ICD-9
Heartburn	787.1
Reflux esophagitis	530.11
Esophageal reflux	530.81

These ICD-9 codes, present in any diagnostic field, will be used to identify GERD patients during the measurement period, regardless of corresponding CPT codes.

Table GERD-B: Codes to identify clinically relevant services during a GERD episode**Table GERD-B1. Diagnostic codes to identify clinically relevant services during a GERD episode**

Description	ICD-9
Heartburn	787.1
Esophagitis	530.1, 530.1*
Esophageal reflux	530.81
Hoarseness, dysphonia	784.49
Cough, night cough	786.2
Nighttime wheezing	786.07
Asthma	493.**
Globus hystericus (globus pharyngeus)	300.11
Regurgitation	307.53
Dyspepsia	
Dyspepsia & other specified disorders of function of stomach	536.8
Gastrointestinal (Psychogenic dyspepsia)	306.4
Hyperemia of vocal cords, edema of larynx	478.6
Erythema of vocal cords	478.5
Laryngitis	464.0*, 464.1*, 464.2*
Chronic laryngotracheitis	476.*
Other diseases of the larynx	478.2
Obstructive sleep apnea	327.23
Unspecified sleep apnea	780.57
Abdmnl Pain Epigastric	789.06

These ICD-9 codes, present in any diagnostic field, will be used to identify GERD-related services during the measurement period, regardless of corresponding CPT codes.

Table GERD-B2. Evaluation and management codes

Description	CPT Codes
General physician office visits	99201-99205, 99211-99215
Preventive medicine/screening	99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99384-99387
Observation care	99217-99220
Emergency dept care	99281-99285
Home health	99341-99345, 99347-99350
Skilled nursing facility	99304-99310, 99315, 99316, 99318,

	99324-99328, 99334-99337
Office consultation	99241-99245
Unlisted	99455, 99456

These codes will be used to help identify those services that should be categorized as “E&M” during our analyses. Such services, when present in the identification (pre-measurement) period, are used to identify patients for the measure’s denominator. When present during the measurement period, these services are counted to determine the provider or providers to whom the episode will be attributed.

Table GERD-C: Procedure codes to identify procedures and laboratory services relevant to a GERD episode

Description	CPT Codes
Endoscopy	00740, 43200-43205, 43215, 43216, 43220, 43226, 43234-43239, 43242-43245, 43247-43251, 43255, 43256, 43258, 43259
Barium swallow x-ray	74246-74249
Esophageal ph studies	91034-91035
Esophageal impedance (function tests)	91037-91038
Esophageal motility/manometry	78258, 91010-91012
Bernstein test	91030
Capsule endoscopy	91110-91111
Laryngoscopy	31505-31579
Gastric emptying study	78264
Upper GI series	
X-ray exam, upper GI tract	74240-74245

These procedure codes will be used to identify GERD-related services during the measurement period, regardless of ICD-9 codes.

Table GERD-D: Procedure codes to identify surgical procedures relevant to a GERD episode

Description	CPT
Nissen fundoplication, Hill repair, Belsey Mark IV operation, Toupet fundoplication	43324-43326, 43280
Esophageal dilation	43450, 43453, 43456, 43458
Esophageal myotomy	43279, 43330,

	43331
NDO Plicator, EndoCinch endoluminal gastroplication (sunset 2008), Stretta procedure (sunset 2008), EsophyX (transoral fundoplication), Medigus fundoplication	
Uppr GI scope w/thrml txmnt	43257
Laparoscope proc, esoph	43289
Esophagus surgery procedure	43499

These procedure codes will be used to identify GERD-related services during the measurement period, regardless of corresponding ICD-9 codes.

Table GERD-E: Prescription medications identified as related to a GERD episode (all during the measurement period)

Class	Medications
Proton pump inhibitors	omeprazole, esomeprazole, lansoprazole, rabeprazole, and pantoprazole
H2 receptor antagonists	ranitidine, cimetidine, famotidine, nizatidine
Coating agents	sucralfate
Erythromycin	
Antacids	magnesium carbonate, magnesium hydroxide, aluminum hydroxide, simethicone

Table GERD-F: Codes to identify exclusions

Table GERD-FI. Diagnoses that trigger GERD episode

Description	ICD-9
Heartburn	787.1
Reflux esophagitis	530.11
Esophageal reflux	530.81

Exclude patients who had any claim for heartburn, reflux esophagitis, or esophageal reflux (i.e., GERD trigger diagnoses) during the 6-months prior to the claim that triggered the GERD episode.

Exclude patients with any of the following during the measurement year or year prior to the measurement year (i.e., 12-months before and after the trigger diagnosis).

Table GERD-F2: 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 GERD-F3: ESRD

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 CAD-F4: Organ transplant

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 GERD-F5: HIV-AIDS

Description	ICD-9-CM Diagnosis
HIV	042

Table GERD-F6: Pregnancy

Description	CPT	ICD-9-CM Diagnosis
Normal Pregnancy		V22.x
Treat ectopic pregnancy	59120, 59121, 59130, 59135, 59136, 59140, 59150, 59151	
D & c after delivery	59160	
Insertion of cervical dilator	59200	
Episiotomy or vaginal repair	59300	
Revision of cervix	59320, 59325	
Repair of uterus	59350	
Obstetrical care	59400, 59409, 59410	
Antepartum manipulation	59412	
Deliver placenta	59414	
Antepartum care only	59425, 59426	
Care after delivery	59510, 59514, 59515, 59525	
Vbac delivery	59610, 59612, 59614	
Attempted vbac delivery	59618, 59620, 59622	
Treatment of miscarriage	59812, 59820, 59821	
Treat uterus infection	59830	
Abortion	59840, 59841, 59850, 59851, 59852, 59855, 59856, 59857, 59866	
Remove cerclage suture	59871	
Fetal invas px w/us	59897	
Laparo proc, ob care/deliver	59898	
Maternity care procedure	59899	
Ob us < 14 wks	76801, 76802	
Ob us >= 14 wks	76805, 76810	
Ob us	76811, 76812, 76813, 76814, 76815, 76816,	
Transvaginal us	76817	
Fetal biophys profile	76818, 76819	
Umbilical artery echo	76820	

Middle cerebral artery echo	76821	
Echo exam of fetal heart	76825	
Anesth	01958, 01960,01961	
Complications of pregnancy, childbirth, and the puerperium		630-676

Table GERD-F7. Other diagnoses to identify patients for exclusion from GERD measure

Description	ICD-9
Strictures	530.3, 750.3
Anemia	280.**, 281.**, 282.**, 283.**, 284.**, 285.**, 648.2, 648.2*, 678.0*, 776.5, 776.6
End-stage liver disease	571.*, 572.*, 573.9
Familial polyposis (colon polyps)	211.3, V12.72, V18.51
GI-bleed	
Gastrointestinal hemorrhage	578.*
Angiodysplasia of stomach and duodenum with hemorrhage	537.83
Abnormal weight loss	783.2
Aspiration	507.0
Dysphagia	787.2*
Persistent vomiting	536.2
Vomiting alone	787.03
Hematemesis	578.0
Gastritis	535.**
Gall stones	574.**
Ulcer-diseases (e.g., peptic ulcer disease)	530.2*, 531.**-534.**
Barrett's esophagus	530.85
Familial history of GI-tract cancer	V16.0

Risk Adjustment Method

Comorbid conditions indentified as HCCs in 12 months preceding event date using inpatient and outpatient ICD-9 codes.

Episode Severity / Disease Staging

Stratify by presence of Hiatal Hernia

Table GERD-G. Hiatal hernia

Description	ICD-9
Hiatal hernia	553.3, 553.9, 750.6

Level of Measurement/Analysis

Measurement will take place at the level of the individual physician. All E&M codes for GERD care on separate dates during the measurement year will be identified (for acute care, count only one claim per event).

Costs and resource use assigned to a single provider if that physician has at least 70% of the E&M claims during the measurement period (“single attribution”); OR
 If no provider has more than 70% of the E&M claims, costs and resource use are assigned to each of the providers that have at least 30% of the E&M claims for a patient during the measurement period (“multiple attribution”); OR
 If no provider has at least 30% of the E&M claims during the measurement period, the costs and resource use for that patient are not attributed to any provider (“no attribution”).

Technical Appendix

Episodes-of-Care for 12-Week Period of GERD Treatment

Appendix Overview

The following document provides step-by-step methods for implementing the Episode-of-Care for Patients with gastroesophageal reflux disease (GERD) care over a 12-week period following diagnosis and 8 weeks prior to diagnosis measured 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 associated with management of patients with GERD over a 12-week period following diagnosis and 8 weeks prior to diagnosis. Episode-related resource use for patients with GERD is identified and standardized costs are applied. Total GERD-related costs are calculated for each patient and summarized at the attributable provider level. Observed costs are compared to risk-adjusted expected costs at the provider 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. The 24-month period includes a 12-month identification period and a 12-week measurement period after diagnosis and 8-week measurement period before diagnosis.

Definitions

Identification period	12-month period used to identify patients eligible for inclusion in the measure
Triggering event	An ambulatory visit with a diagnosis of heartburn, reflux esophagitis, or esophageal reflux during the identification period
Prior period	12-month period before the triggering event
Measurement period	Period over which GERD-related resource use is measured; 12 weeks immediately follows triggering event and 8 weeks before the triggering 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 period will be defined as the patient's age at the first day of the identification period.
GERD-related¹	Healthcare encounters defined as being related to GERD care
Continuous enrollment	As identified in eligibility or enrollment information, full medical and pharmacy benefit enrollment during both the prior period and the measurement period
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

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

Section I – Eligible Population Identification

The process of identifying patients to be included in the measure is divided into four 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

- I. Identify patients that meet the following criteria

Patients included in the measure must have an ambulatory visit with a diagnosis of heartburn, reflux esophagitis, or esophageal reflux (See **Table GERD-A** for codes).

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

1. Age
 - a. Identify patients 12 years and older
2. Eligibility
 - a. Identify benefits during the measurement and prior period
 - b. To be included persons must have both of the following benefits
 - i. Medical benefit
 - ii. Pharmacy benefit
3. Continuous enrollment
 - a. Determine enrollment during both the measurement and prior period
 - 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

- I. Identify patients that meet one or more exclusion criteria during the 6-month period before the triggering event:
 - Patients with any of the following diagnoses (GERD trigger diagnoses) (See **Table GERD-A** for codes):
 - diagnoses of heartburn
 - reflux esophagitis
 - esophageal reflux

2. Identify patients that meet one or more exclusion criteria during the prior period OR the measurement period (**Tables GERD-F2 – GERD-F7**)

Step 4: Combine prior steps to identify measure population

1. Identify eligible GERD 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 following paid claims for services rendered during the measurement period. Claims / encounters will be identified based on the presence of GERD-related diagnosis codes or procedure codes. These events will be used to determine the related resource use.

Inpatient and Outpatient events

Identify all inpatient and outpatient claims / encounters with a GERD-related diagnostic code appearing in *any* position (see **Table GERD-BI**).

Procedures and laboratory

Identify all claims / encounters with one of the following CPT codes (see **Tables GERD-C, GERD-D**). These procedure codes will be used to identify GERD-related services during the measurement period, regardless of corresponding ICD-9 diagnosis codes.

Prescription drugs

Identify GERD-related medications by therapeutic class or generic/brand medication name during the measurement period (See **Table GERD-E**):

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 GERD-related.

Standard Cost Calculation

- Step 1** Identify all claims paid for services rendered during the measurement period 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 followed in Step 3 above):
- *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, 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, multiply the 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 period. Include stays that may have started before the measurement period or ended after the close of the measurement period. 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 period. Also identify the stay's LOS group based on the stay's LOS and the information contained in Table GERD-LOS below.

Table GERD-LOS: 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 period, use the total number of paid days as the per diem multiplier. If the inpatient stay does not fall completely inside the measurement period, count only the days within the measurement period (including the last day of the period) 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 periods. 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.

² The C3 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.

Example³ Assume the calculated DRG-specific per-diem payment rate for DRG 127 for FY 2007 is \$900.17. An eligible member had an inpatient stay with the following characteristics:

- A principal diagnosis of 414.2
- A DRG of 127 (Heart Failure and Shock)
- A measurement period with a trigger event on January 1, 2007 would end on March 25, 2007
- 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 127 for FY 2007 is \$900.17. An eligible member had an inpatient stay with the following characteristics:

- A principal diagnosis of 414.2
- A DRG of 127 (Heart Failure and Shock)
- A measurement period with a trigger event on January 1, 2007 would end on March 25, 2007
- Date of admission of March 23, 2007 and date of discharge of March 29, 2007
- A LOS of 6 days, and a LOS per diem multiplier of 2 days (March 24-25).

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.

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

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.

- 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 493.1 (eligible event), and therefore ADSC category Respiratory-C (RESC)
- 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 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 period. The following pharmacy services should also be included:
- Prescriptions that may have been dispensed before the measurement period and had days supply that extended into the measurement period (e.g., a prescription with a dispensed date of December 15, 2007 and 30 days supply would extend 13 days into a measurement period beginning January 1, 2008)
 - Prescriptions that may have been dispensed during the measurement period and had days supply that extended beyond the measurement period (e.g., a prescription with a dispensed date of December 20, 2007 for a 30 days supply if the measurement period ended on December 31, 2007)

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 period.
- 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 period, 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 period, count only the days within the measurement period (including the last day of the period) 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 period. 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 period.
- 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 period. 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

Patients included in the GERD measure will be stratified by whether patients did or did not have a hiatal hernia diagnosis (see Table GERD-G).

Table GERD-G. Hiatal hernia

Description	ICD-9
Hiatal hernia	553.3, 553.9, 750.6

Section 5 – Calculation of total individual episode costs

The resource use identified as GERD-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 GERD-related events occurring during the measurement period at the 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 GERD-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:

I. 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 period.

3. Tested 12 different model specifications shown in Table GERD-RA1, 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., GERD), 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.

Table GERD-RA1. 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 GERD episode.

Risk Adjustment Model

GERD 12 Wk Risk Adjusted Costs = \$269 + (Age*\$4) + (Major Depressive, Bipolar, and Paranoid Disorders*\$63) + (Chronic Obstructive Pulmonary Disease*\$174) + (Diabetes with Neurologic or Other Specified Manifestation*\$57) + (Diabetes without Complication*\$30) + (Intestinal Obstruction/Perforation*\$176) + (Pancreatic Disease*\$208) + (Inflammatory Bowel Disease*\$100) + (Disorders of Immunity*\$143) + (Polyneuropathy*\$72) + (Multiple Sclerosis*\$93) + (Seizure Disorders and Convulsions*\$83) + (Cardio-Respiratory Failure and Shock*\$255) + (Congestive Heart Failure*\$96) + (Acute Myocardial Infarction*\$102) + (Unstable Angina and Other Acute Ischemic Heart Disease*\$235) + (Angina Pectoris/Old Myocardial Infarction*\$142) + (Specified Heart Arrhythmias*\$53) + (Cerebral Palsy and Other Paralytic Syndromes*\$144) + (Vascular Disease with Complications*\$101) + (Vascular Disease*\$52) + (Cystic Fibrosis*\$405) + (Aspiration and Specified Bacterial Pneumonias*\$257) + (Pneumococcal Pneumonia, Emphysema, Lung Abscess*\$203) + (Decubitus Ulcer of Skin*(\$189)) + (Major Head Injury*\$84) + (Vertebral Fractures without Spinal Cord Injury*\$117) + (Hip Fracture/Dislocation*\$209) + (Major Complications of Medical Care and Trauma*\$60)

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 period, 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 GERD-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 GERD-RA2. Summary estimate of the average cost for the test episode

	Average Cost
GERD	\$542

Example: To calculate the inflation factor, determine the average episode cost for the population to which the measure is being applied. As an example, the average cost might be = \$650. Calculate the adjustment factor by dividing the costs from the current population by the average costs in Table GERD-RA2. That would result in an adjustment factor = 1.20 (=650/542). These adjustment factors are then applied to the estimated coefficients to provide an adjusted risk adjustment model.

Adjusted Risk Adjustment Model

Risk and Mean Adjusted GERD Episode Costs = 1.20 * GERD Episode Risk Adjusted Cost

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

Section 7 – Determination of attributable provider

Resource use and costs for GERD episodes are attributed to one or more physicians on a hierarchical basis. The total counts of E&M codes by unique provider ID are used for provider attribution. For each episode identify all such E&M services occurring during the measurement period. The E&M codes are used to assign attribution using the following hierarchy:

1. Costs and resource use assigned to a single provider if that physician has at least 70% of the E&M claims during the measurement period (“single attribution”); OR
2. If no provider has more than 70% of the E&M claims, costs and resource use are assigned to each of the providers that have at least 30% of the E&M claims for a patient during the measurement period (“multiple attribution”); OR
3. If no provider has at least 30% of the E&M claims during the measurement period, the costs and resource use for that patient are not attributed to any provider (“no attribution”).

To identify the attributable provider, the following steps will be used:

Step 1: Identify qualifying E&M codes for the episode from **Table GERD-B2**.

Step 2: For each individual included in the episode, sum the total qualifying E&M visits by each provider for that individual.

Step 3: Calculate the proportion of E&M visits for each provider that had a claim for each of the patients:

- Proportion of Care = Total count of provider’s E&M qualifying claims divided by total count of all qualifying E&M claims

Step 4: Assign attribution based on the hierarchical attribution model described above.

Section 8 – Creation of provider summaries

The provider summaries are a report of the resource use for an individual provider compared to their peer group, their non-peer group and all episodes in the dataset. Creation of the provider summaries uses the summary episode costs combined with the attributable provider data and the risk adjusted episode costs.

Step 1: Create a dataset that includes the following information: patient ID, total episode cost, attributable provider ID, attributable provider specialty type 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 provider.

Step 4: Summarize the observed, expected and observed-to-expected ratio for each provider type.

Step 6: Summarize the observed, expected and observed-to-expected ratio for the all of the episodes.

Step 7: For each attributable provider, determine the proportion of observed-to-expected ratios above the 75% percentile of the peer group and calculate the 95% confidence interval

Step 8: Create provider summary reports for each attributable provider in the dataset (See Table GERD-Provider Summary for example)

GERD 12 Week Episode (Without Hiatal Hernia)

Report for Physician #50946016

Provider type = Internal Medicine

	MD	Peer Group	Non-Peer Group	National Avg
Episodes	20	6184	27,490	62,037
Observed Costs*				
Average	\$ 674	\$ 882	\$ 968	\$ 987
Min	\$ 96	\$ 65	\$ 65	\$ 65
Median	\$ 282	\$ 413	\$ 501	\$ 526
Max	\$ 3743	\$ 6036	\$ 6036	\$ 6036
Predicted Costs				
Average	\$ 1013	\$ 1020	\$ 979	\$ 984
Min	\$ 576	\$ 469	\$ 302	\$ 302
Median	\$ 1051	\$ 1029	\$ 987	\$ 993
Max	\$ 1166	\$ 3544	\$ 4441	\$ 4798
Observed-to-Expected Ratio				
Average	0.75	0.86	0.99	1.00
Min	0.09	0.03	0.02	0.02
Median	0.27	0.43	0.55	0.57
Max	5.26	9.86	12.70	12.88
% ≥ 2.0	10.0%	9.4%	12.6%	13.1%
% ≥ 2.5	10.0%	5.0%	7.2%	7.4%

% ≥ 75th percentile peers 11.8% (1.5%, 36.4%)

* Observed costs adjusted for outliers (winsorized)

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 GERD 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 period from the CMS website.

Step 2: Combine 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 a BETOS code to combine with the eligible events data. Similarly, categorize data from inpatient hospital files as inpatient facility-related costs.

Step 4: Categorize BETOS codes into the 7 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 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 GERD-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

- For each type-of-service category for non-inpatient, non-pharmacy claims, summaries of the 20 CPT and HCPCs codes among non-GERD-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 related and non-related to the GERD episode
- For pharmacy claims, the 20 generic drug names and therapeutic classes most commonly appearing and accounting for the largest proportions of pharmacy costs: both related and non-related to the GERD episode.