



American Board
of Medical Specialties

Higher standards. Better care.®

Research and Education Foundation

Episode-based Resource Use Measures

Episode-of-Care for Patients with Asthma over a 1-year Period

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.

These Measures are intended to assist physicians in enhancing quality of care. Measures are designed for use by any physician who manages the care of a patient for a specific condition or for prevention. These Measures are not clinical guidelines and do not establish a standard of medical care. The ABMS REF has not tested its Measures for all potential applications. The ABMS REF encourages the testing and evaluation of its Measures. Measures are subject to review and may be revised or rescinded at any time by the ABMS REF. The Measures may not be altered without the prior written approval of the ABMS REF. The Measures developed by the ABMS REF, while copyrighted, can be reproduced and distributed, without modification, for noncommercial purposes, e.g., use by health care providers in connection with their practices. Commercial use is defined as the sale, license, or distribution of the Measures for commercial gain, or incorporation of the Measures into a product or service that is sold, licensed or distributed for commercial gain. Commercial uses of the Measures require a license agreement between the user and ABMS REF. Neither the ABMS REF nor its members shall be responsible for any use of these Measures.

Portions of the exclusion criteria in the ABMS REF episode-based resource use measures were adapted from HEDIS® measure specifications.

Limited proprietary coding is contained in the Measure specifications for convenience. Users of the proprietary code sets should obtain all necessary licenses from the owners of these code sets. The ABMS REF disclaims all liability for use or accuracy of coding contained in the specifications.

Current Procedural Terminology (CPT®) contained in the Measures specifications is copyright 2004 -2010 American Medical Association. All rights reserved.

THE MEASURES ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND.

Asthma Measure Workgroup Members

Dickson Cheung, MD
Troy Fiesinger, MD
Michael Foggs, MD
Paul Greenberger, MD
Carol Jones, RN
David Lang, MD
Allan Lieberthal, MD
Praveen Mathur, MD
Theresa Prosser, PharmD

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 Patients with Asthma over a 1-year Period

Measure Description

Resource use and costs associated with management of patients with asthma care over a one-year period. Patients with asthma are identified in the year preceding the measurement year and asthma-related resource use and costs are identified during the measurement year. Resource use is evaluated separately for three age strata with the measure: 5-12, 13-50 and 50+ years. Costs of care are attributed in one of three ways: 1) to a single physician if that provider has more than 70% of the asthma-related E&M codes; 2) to all providers that had 30% or more and 70% or less of E&M codes if no provider has more than 70% of visits; 3) no attribution if no provider has at least 30% of E&M codes during the measurement year.

Required Data Elements

Administrative claims data

Calculation

For patients meeting inclusion criteria, determine asthma-related resource use and costs over a one-year period in the measurement year. Prices from a standard price list will be applied to the resource use to estimate the costs of the episode of care. 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) other and 10) outpatient facility. 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 each of the other resource use categories, standardized prices will be available for each of the unique codes available under the other four categories.

Episode Definition

Asthma-related care over a one year period.

Rationale

The Institute of Medicine and AQA (formerly known as the Ambulatory Care Quality Alliance) have identified asthma 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. Asthma is estimated to affect nearly 20 million Americans. Asthma had also been previously identified as a priority area in other national initiatives including the Agency for Healthcare Research and Quality's (Medical Expenditure Panel Survey and Health Resources and Services Administration's Health Disparities Collaboratives. In addition, the costs of treatment for asthma patients can be very high in some cases. Each year asthma costs the U.S. economy an estimated \$14.7 billion in direct health care costs, and the cost of treating asthma for those under 18 years of age is estimated to be \$3.2 billion a year. It is estimated that asthma accounts for 1 in 4 emergency department visits in the United States.

Because asthma is a chronic condition, this measure will focus on the resources used over a 12-month time period. Resources included in the measure will be identified during the year preceding the measurement year to ensure incident cases in the measurement year are not included in the measure as treatment patterns and resource consumption may be different for those with newly diagnosed asthma. This measure's inclusion criteria are intended to increase the measure's specificity also because of the frequency with which asthma patients are misclassified as chronic obstructive pulmonary disease (COPD) in the claims record, particularly among older patients – for this reason resource use and costs will be estimated separately for three groups those 5-12 years old, 13-50 years of age and for those older than 50 years. This stratification also conforms with National Committee for Quality Assurance's measures of quality of care related to asthma. Patients with three or more asthma-related hospitalizations either during the identification or measurement year will be excluded from the measure as they represent a population with uncontrolled or difficult to treat asthma and would likely be outliers in the analysis.

Measures

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

Eligible Population

Age	Those ≥ 5 years of age during the identification year are eligible for inclusion
Enrollment Criteria	Continuous medical and pharmacy benefit enrollment during the identification 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 meet the following criteria during the identification year: 1) Two claims with a diagnosis of asthma (see Table ASTHMA-A) separated by at least 60 days <i>and</i> One prescription for an asthma medication (see Table ASTHMA-B)
Exclusion	Persons meeting the following criteria during either the identification or measurement year will be excluded : <ul style="list-style-type: none">- Chronic oral steroid use (≥ 180 day supply during either identification or measurement year) See Table ASTHMA-E1- 3 or more asthma hospitalizations in either the measurement year or identification year See Table ASTHMA-A- Any of the following conditions (see Tables ASTHMA-E2-5)<ul style="list-style-type: none">- Active cancer (excluding melanoma, skin, prostate, and CLL)- End stage renal disease (ESRD)- HIV/AIDS- Organ transplant- Cystic fibrosis- Interstitial lung disease- Vocal cord dysfunction- Eosinophilic esophagitis- Bronchiectasis- Common variable immune deficiency- CHF- Hypersensitivity pneumonitis For those 50+ years, the following represent additional exclusion criteria: <ul style="list-style-type: none">- COPD

- Chronic bronchitis
- emphysema

Table ASTHMA-A: Asthma diagnosis code for cohort identification

Description	ICD-9 Code
Asthma	493.x

This ICD-9 code, present in **any** diagnostic field, will be used in tandem with the drug codes in Table ASTHMA-B below to identify asthma patients during the measurement period.

Table ASTHMA-B: Asthma medications for cohort identification

Class	Medication
Short-acting beta-agonists (inhaled)	
Long-acting beta-agonists	Salmeterol; formoterol
Methylxanthines	Theophylline; Aminophylline
Inhaled corticosteroids and oral steroids	beclamethasone, budesonide, ciclesonide, fluticasone, flunisolide, mometasone, triamcinolone,
Leukotriene modifiers	montelukast, zafirlukast
Mast cell stabilizers	cromolyn (orally inhaled)
Anti-IgE monoclonal antibody	Omalizumab
Anticholinergics	ipratropium, tiotropium
Combination products incorporating 2 or more of the above medications	(e.g., Combivent, Symbicort, Advair)

Table ASTHMA-C 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

These codes will be used to help identify those services that should be categorized as “E&M”. To be included codes must have an asthma-related diagnosis code.

Tables ASTHMA-D: Codes to identify asthma-related resource use

Table ASTHMA-D1 Asthma-related diagnostic codes

Description	ICD-9 Code
Asthma	493.x
Acute bronchitis and bronchiolitis	466.x
Bronchitis	490
Chronic sinusitis	473.x
Allergic rhinitis	477.x
GERD	530.11, 530.81
Obstructive sleep apnea	780.57
Cough	786.2
Dyspnea	786.09
Wheezing	786.07
Shortness of breath	786.05
Acute respiratory failure	518.81
Other pulmonary insufficiency not elsewhere classified	518.82
Acute and chronic respiratory failure	518.84
Respiratory arrest	799.1
Morbid obesity	278.01

These ICD-9 codes, present in *any* diagnostic field on an outpatient claim or in the *primary* diagnosis field for a hospitalization identify asthma-related resource use

Table ASTHMA-D2 Asthma-related medications

Class	Medication
Short-acting beta-agonists (inhaled, oral)	
Long-acting beta-agonists	salmeterol; formoterol
Methylxanthines	theophylline; aminophylline
Inhaled corticosteroids and oral steroids	beclamethasone, budesonide, ciclesonide, fluticasone, flunisolide, mometasone, triamcinolone, prednisone, prednisolone
Leukotriene modifiers	montelukast, zafirlukast
Mast cell stabilizers	cromolyn (orally inhaled)

Episode-based Resource Use Measures: Asthma

Anti-IgE monoclonal antibody	Omalizumab
Antihistamines	
Anticholinergics	Ipratropium, tiotropium
Combination products incorporating 2 or more of the above medications	(e.g., Combivent, Symbicort, Advair)
Short-course antibiotics ^a	penicillins, cephalosporins, macrolides, TMP/SMZ, quinolones
Short-course proton pump inhibitors ^b	omeprazole, esomeprazole, lansoprazole, rabeprazole, pantoprazole
Short-course intranasal steroids ^b	beclamethasone, budesonide, dexamethasone, flunisolide, fluticasone, mometasone, triamcinolone [Brand Names: Beconase, Beconase AQ, Dexacort Turbinaire, Flonase, Nasacort, Nasacort AQ, Nasalide, Nasarel, Nasonex, Rhinocort, Vancenase, Vancenase AQ, Vancenase pockethaler]

^a Only including antibiotics with < 3 weeks of consecutive treatment

^b Only include medications if less than or equal to 3 consecutive months of treatment

HCPC	Description
Asthma medications	
J2357	INJECTION, OMALIZUMAB, 5 MG
J7602	ALBUTEROL, ALL FORMULATIONS INCLUDING SEPARATED ISOMERS, INHALATION SOLUTION,
J7603	ALBUTEROL, ALL FORMULATIONS INCLUDING SEPARATED ISOMERS, INHALATION SOLUTION,
J7604	ACETYLCYSTEINE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7605	ARFORMOTEROL, INHALATION SOLUTION, FDA APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7607	LEVALBUTEROL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7608	ACETYLCYSTEINE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7609	ALBUTEROL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7610	ALBUTEROL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7611	ALBUTEROL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7612	LEVALBUTEROL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7613	ALBUTEROL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7614	LEVALBUTEROL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7615	LEVALBUTEROL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7616	ALBUTEROL, UP TO 5 MG AND IPRATROPIUM BROMIDE, UP TO 1 MG, COMPOUNDED
J7617	LEVALBUTEROL, UP TO 2.5 MG AND IPRATROPIUM BROMIDE, UP TO 1 MG, COMPOUNDED
J7618	ALBUTEROL, ALL FORMULATIONS INCLUDING SEPARATED ISOMERS, INHALATION SOLUTION

Episode-based Resource Use Measures: Asthma

J7619	ALBUTEROL, ALL FORMULATIONS INCLUDING SEPARATED ISOMERS, INHALATION SOLUTION
J7620	ALBUTEROL, UP TO 2.5 MG AND IPRATROPIUM BROMIDE, UP TO 0.5 MG, FDA-APPROVED
J7621	ALBUTEROL, ALL FORMULATIONS, INCLUDING SEPARATED ISOMERS, UP TO 5 MG
J7622	BECLOMETHASONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7624	BETAMETHASONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7626	BUDESONIDE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7627	BUDESONIDE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7628	BITOLTEROL MESYLATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7629	BITOLTEROL MESYLATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7631	CROMOLYN SODIUM, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7632	CROMOLYN SODIUM, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7633	BUDESONIDE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT, NON-COMPOUNDED,
J7634	BUDESONIDE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7635	ATROPINE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7636	ATROPINE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7637	DEXAMETHASONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7638	DEXAMETHASONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7640	FORMOTEROL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7641	FLUNISOLIDE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH DME,
J7642	GLYCOPYRROLATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7643	GLYCOPYRROLATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7644	IPRATROPIUM BROMIDE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7645	IPRATROPIUM BROMIDE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7647	ISOETHARINE HCL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7648	ISOETHARINE HCL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7649	ISOETHARINE HCL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7650	ISOETHARINE HCL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7657	ISOPROTERENOL HCL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7658	ISOPROTERENOL HCL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7659	ISOPROTERENOL HCL, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7660	ISOPROTERENOL HCL, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7667	METAPROTERENOL SULFATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, CONCENTRATED
J7668	METAPROTERENOL SULFATE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7669	METAPROTERENOL SULFATE, INHALATION SOLUTION, FDA-APPROVED FINAL PRODUCT,
J7670	METAPROTERENOL SULFATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7674	METHACHOLINE CHLORIDE ADMINISTERED AS INHALATION SOLUTION THROUGH A NEBULIZER,

Episode-based Resource Use Measures: Asthma

J7680	TERBUTALINE SULFATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7681	TERBUTALINE SULFATE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED
J7683	TRIAMCINOLONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7684	TRIAMCINOLONE, INHALATION SOLUTION, COMPOUNDED PRODUCT, ADMINISTERED THROUGH
J7699	NOC DRUGS, INHALATION SOLUTION ADMINISTERED THROUGH DME
S0107	INJECTION, OMALIZUMAB, 25 MG
J1180	INJECTION, DYPHYLLINE, UP TO 500 MG
J2810	INJECTION, THEOPHYLLINE, PER 40 MG
Steroids^b	
J0702	INJECTION, BETAMETHASONE ACETATE 3MG AND BETAMETHASONE SODIUM PHOSPHATE 3MG
J0704	INJECTION, BETAMETHASONE SODIUM PHOSPHATE, PER 4 MG
J1020	INJECTION, METHYLPREDNISOLONE ACETATE, 20 MG
J1030	INJECTION, METHYLPREDNISOLONE ACETATE, 40 MG
J1040	INJECTION, METHYLPREDNISOLONE ACETATE, 80 MG
J1094	INJECTION, DEXAMETHASONE ACETATE, 1 MG
J1100	INJECTION, DEXAMETHASONE SODIUM PHOSPHATE, 1MG
J1110	INJECTION, DIHYDROERGOTAMINE MESYLATE, PER 1 MG
J1700	INJECTION, HYDROCORTISONE ACETATE, UP TO 25 MG
J1710	INJECTION, HYDROCORTISONE SODIUM PHOSPHATE, UP TO 50 MG
J1720	INJECTION, HYDROCORTISONE SODIUM SUCCINATE, UP TO 100 MG
J2650	INJECTION, PREDNISOLONE ACETATE, UP TO 1 ML
J2920	INJECTION, METHYLPREDNISOLONE SODIUM SUCCINATE, UP TO 40 MG
J2930	INJECTION, METHYLPREDNISOLONE SODIUM SUCCINATE, UP TO 125 MG
J7506	PREDNISONE, ORAL, PER 5MG
J7509	METHYLPREDNISOLONE ORAL, PER 4 MG
J7510	PREDNISOLONE ORAL, PER 5 MG
Antibiotics^a	
J0200	INJECTION, ALATROFLOXACIN MESYLATE, 100 MG
J0278	INJECTION, AMIKACIN SULFATE, 100 MG
J0290	INJECTION, AMPICILLIN SODIUM, 500 MG
J0295	INJECTION, AMPICILLIN SODIUM/SULBACTAM SODIUM, PER 1.5 GM
J0456	INJECTION, AZITHROMYCIN, 500 MG
J0530	INJECTION, PENICILLIN G BENZATHINE AND PENICILLIN G PROCAINE, UP TO 600,000
J0540	INJECTION, PENICILLIN G BENZATHINE AND PENICILLIN G PROCAINE, UP TO 1,200,000
J0550	INJECTION, PENICILLIN G BENZATHINE AND PENICILLIN G PROCAINE, UP TO 2,400,000
J0560	INJECTION, PENICILLIN G BENZATHINE, UP TO 600,000 UNITS
J0570	INJECTION, PENICILLIN G BENZATHINE, UP TO 1,200,000 UNITS
J0580	INJECTION, PENICILLIN G BENZATHINE, UP TO 2,400,000 UNITS
J0690	INJECTION, CEFAZOLIN SODIUM, 500 MG
J0692	INJECTION, CEFEPIME HYDROCHLORIDE, 500 MG
J0694	INJECTION, CEFOXITIN SODIUM, 1 GM
J0696	INJECTION, CEFTRIAZONE SODIUM, PER 250 MG
J0697	INJECTION, STERILE CEFUROXIME SODIUM, PER 750 MG
J0698	INJECTION, CEFOTAXIME SODIUM, PER GM
J0710	INJECTION, CEPHAPIRIN SODIUM, UP TO 1 GM

Episode-based Resource Use Measures: Asthma

J0713	INJECTION, CEFTAZIDIME, PER 500 MG
J0715	INJECTION, CEFTIZOXIME SODIUM, PER 500 MG
J0720	INJECTION, CHLORAMPHENICOL SODIUM SUCCINATE, UP TO 1 GM
J0744	INJECTION, CIPROFLOXACIN FOR INTRAVENOUS INFUSION, 200 MG
J1335	INJECTION, ERTAPENEM SODIUM, 500 MG
J1364	INJECTION, ERYTHROMYCIN LACTOBIONATE, PER 500 MG
J1580	INJECTION, GARAMYCIN, GENTAMICIN, UP TO 80 MG
J1590	INJECTION, GATIFLOXACIN, 10MG
J1840	INJECTION, KANAMYCIN SULFATE, UP TO 500 MG
J1850	INJECTION, KANAMYCIN SULFATE, UP TO 75 MG
J1890	INJECTION, CEPHALOTHIN SODIUM, UP TO 1 GRAM
J1956	INJECTION, LEVOFLOXACIN, 250 MG
J2020	INJECTION, LINEZOLID, 200MG
J2280	INJECTION, MOXIFLOXACIN, 100 MG
J2460	INJECTION, OXYTETRACYCLINE HCL, UP TO 50 MG
J2510	INJECTION, PENICILLIN G PROCAINE, AQUEOUS, UP TO 600,000 UNITS
J2540	INJECTION, PENICILLIN G POTASSIUM, UP TO 600,000 UNITS
J2543	INJECTION, PIPERACILLIN SODIUM/TAZOBACTAM SODIUM, 1 GRAM/0.125 GRAMS (1:125
J2700	INJECTION, OXACILLIN SODIUM, UP TO 250 MG
J2770	INJECTION, QUINUPRISTIN/DALFOPRISTIN, 500 MG (150/350)
J3243	INJECTION, TIGECYCLINE, 1 MG
J3260	INJECTION, TOBRAMYCIN SULFATE, UP TO 80 MG
J3370	INJECTION, VANCOMYCIN HCL, 500 MG
S0021	INJECTION, CEFOPERAZONE SODIUM, 1 GRAM
S0032	INJECTION, NAFCILLIN SODIUM, 2 GRAMS
S0034	INJECTION, OFLOXACIN, 400 MG
S0039	INJECTION, SULFAMETHOXAZOLE AND TRIMETHOPRIM, 10 ML
S0040	INJECTION, TICARCILLIN DISODIUM AND CLAVULANATE POTASSIUM, 3.1 GRAMS
S0073	INJECTION, AZTREONAM, 500 MG
S0074	INJECTION, CEFOTETAN DISODIUM, 500 MG
S0077	INJECTION, CLINDAMYCIN PHOSPHATE, 300 MG
S0081	INJECTION, PIPERACILLIN SODIUM, 500 MG
Proton Pump Inhibitors^b	
C9113	INJECTION, PANTOPRAZOLE SODIUM, PER VIAL
S0164	INJECTION, PANTOPRAZOLE SODIUM, 40 MG

^a Only including antibiotics with < 3 weeks of consecutive treatment

^b Only include medications if less than or equal to 3 consecutive months of treatment

Table ASTHMA-D3. Procedures and laboratory

Description	CPT	HCPCs	ICD-9 Procedure
Spirometry	94010, 94014, 94015, 94016, 94060, 94070, 94150, 94200, 94240, 94250, 94260, 94350, 94360, 94370, 94375, 94400, 94450, 94620, 94621		
Chest X-ray	71010 – 71035		

Episode-based Resource Use Measures: Asthma

Chest CT	71250, 71260, 71270		
Sinus X-ray	70210 – 70220		
Sinus CT	70486, 70487, 70488		
Pulse oximetry	31505 – 31579		
Endoscopy, Trachea and Bronchi	31615 – 31656		
Spacers		A4627, S8097, S8100, S8101	
Endoscopy, Esophagus	43200 – 43272		
Peak flow meters		A4614, S8096, S8097, S8110	
Nasopharyngoscopy	92511		
Allergy tests (skin and blood)	95004 – 95078		
Bone densitometry	76075, 76076		
24-hr pH probe	91032, 91033		
Tonometry	92100		
Exhaled NO	95012		
Sleep studies	95086 – 95807		
CF testing – sweat chloride and DNA	83890, 83894, 83896, 83898, 83912		
Serum IG	86003 – 86005		
Barium swallow	92520, 92525, 92526		
Allergen immunotherapy	95115, 95117, 95120, 95125, 95144, 95165, 95180, 95199		
Nebulized Medication Administration			93.94
Nebulizer		A7015, A7016, A7017, A7018	
Injectable epinephrine (exclude ICD-9 of anaphylaxis)		J0170	
Flumist	90660		
Asthma education		S9441	
CBCs	85022-85025		
Ophthalmology consult	92002, 92004, 92012, 92014		
Strep pneumonia antibodies	86317, 86609, 87449		
GERD-testing			
Endoscopy	43234-43259		
Capsule endoscopy	91110-91111		
Laryngoscopy	31505-31579		
Barium swallow x-ray	74246-74249		
Esophageal pH studies	91034-91035		
Esophageal impedance (function tests)	91037-91038		
Esophageal	78258, 91010-91012		

Episode-based Resource Use Measures: Asthma

motility/monometry			
Bernstein test	91030		
CT scan of chest	71250-71270		
MRI of chest	71550-71552		
Gastric emptying study	78264		
Monthly CBCs	85025, 85027		
Fecal occult blood test	82274		
Abdominal ultrasound	76700-76705		
Pulmonary function tests	78596		
Abdominal CT	74150-74170		

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

Tables ASTHMA-E: Codes to Identify Exclusions

Table ASTHMA-EI-Oral Steroids

Class	Medication
Oral steroids	beclamethasone, budesonide, ciclesonide, fluticasone, flunisolide, mometasone, triamcinolone,

Table ASTHMA-E2-Cancer: 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 ASTHMA-E3-ESRD: Codes to Identify 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 ASTHMA-E4-Transplant: Codes to Identify 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 ASTHMA-E5-Other: Codes to other exclusions

Description	ICD-9-CM Diagnosis	Age Criteria
HIV	042	
CF	277.0x	
Interstitial lung disease	506.4, 506.1, 515, 516.3, 714.81, 770.7	
Vocal cord dysfunction	478.3	
Eosinophilic esophagitis	530.13	
Bronchiectasis	494	
Common variable immune deficiency	279.03, 279.06	
CHF	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428, 428.0, 428.1, 428.2, 428.20, 428.22, 428.3, 428.30, 428.32, 428.4, 428.40, 428.42, 428.9	
COPD	496	50+ yrs
Chronic bronchitis	491.x	50+ yrs
Emphysema	492.x	50+ yrs
Hypersensitivity pneumonitis	495.x	

Risk Adjustment Method

Comorbid conditions identified as HCCs in 12 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 the individual physician. Attribution of resource use and costs for a patient will be assigned to a physician or physicians on a hierarchical basis. Total number of E&M codes for the measurement year for asthma-related services will be determined. Inpatient stays count as a single E&M code for the entire stay. Attribution will be assigned using the following hierarchy:

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

Technical Appendix

Episode-of-Care for Patients with Asthma over a 1-year Period

Appendix Overview

The following document provides step-by-step methods for implementing the Episode-of-Care for Patients with Asthma over a 1-year Period 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 associated with management of patients with asthma over a one-year period. Episode-related resource use for patients with asthma is identified and standardized costs are applied. Total asthma-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 is divided into a 12-month identification period and a 12-month measurement period.

Definitions

Identification year	12-month period used to identify patients eligible for inclusion in the measure
Measurement year	12-month period over which asthma-related resource use is measured; immediately follows identification year
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.
Asthma-related¹	Healthcare encounters defined as being related to asthma care
Continuous enrollment	As identified in eligibility or enrollment information, full medical and pharmacy benefit enrollment during both the identification year and the measurement year, with at least 320 total days of coverage during each year ²
Medication dispensing event	Medication dispensing with a positive, non-zero cost.
Inpatient Hospital Event	An acute care 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:

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

² This method was derived using HEDIS methods for determining coverage eligibility. HEDIS rules require that each eligible person have no more than 1 gap in coverage of up to 45 days in each year.

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 meet both of the following criteria during the identification year

Two claims for any services with a diagnosis of asthma (see **Table ASTHMA-A**) in any diagnosis field on the claim, separated by at least 60 days

and

One medication dispensing event for an asthma medication, as identified either by therapeutic class or by generic/brand medication name (see **Table ASTHMA-B**)

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

1. Age
 - a. Identify patients 5 years and older
 - b. Stratify patients into three age groups:
 - i. 5-12 years
 - ii. 13-50 years
 - iii. 51 years or older
2. Eligibility
 - a. Identify benefits during both the identification year and the measurement year
 - b. To be included persons must have both of the following benefits in both years
 - i. Medical benefit
 - ii. Pharmacy benefit
3. Continuous enrollment
 - a. Determine enrollment during both the identification and measurement years
 - b. Identify (or estimate³) total days of coverage in each year
 - c. To be eligible, persons must have at least 320 total days of coverage during each year⁴

³ If precise information regarding persons' total days of coverage is not available, it is recommended that measure implementers estimate this information to the best of their ability using available data elements (e.g., monthly enrollment indicators).

Step 3: Identify patients with exclusion criteria

1. Identify patients that meet one or more exclusion criteria during either the identification year OR the measurement year
2. Exclusion criteria
 - Chronic oral steroid use (a total amount of ≥ 180 days supply during either identification or measurement year) (**Table ASTHMA –E1**)
 - 3 or more inpatient hospital events with a primary diagnosis of asthma (see **Table ASTHMA-A**) in either the measurement year or identification year
 - Patients with codes for the following conditions (**Tables ASTHMA-E2-5**):
 - Active cancer (excluding melanoma, skin, prostate, and chronic lymphocytic leukemia)
 - End stage renal disease (ESRD)
 - HIV/AIDS
 - Organ transplant
 - Cystic fibrosis (CF)
 - Interstitial lung disease
 - Vocal cord dysfunction
 - Eosinophilic esophagitis
 - Bronchiectasis
 - Common variable immune deficiency
 - Chronic heart failure (CHF)
 - Hypersensitivity pneumonitis

For those age 50 years or older, the following represent additional exclusion criteria:

- Chronic obstructive pulmonary disease (COPD)
- Chronic bronchitis
- Emphysema

Step 4: Combine prior steps to identify measure population

1. Identify asthma 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 following paid claims for services rendered during the measurement year. Claims / encounters will be identified

⁴ This method was derived using HEDIS methods for determining coverage eligibility. HEDIS rules require that each eligible person have no more than 1 gap in coverage of up to 45 days in each year.

based on the presence of asthma-related diagnosis codes or procedure codes. These events will be used to determine the asthma-related resource use.

Inpatient hospitalization events

Identify all inpatient hospitalization events with one of the following diagnosis codes appearing in the **primary** diagnosis field only.

Description	ICD-9 Code
Asthma	493.x
Acute bronchitis and bronchiolitis	466.x

Outpatient events

Referring to **Table ASTHMA-D1**, identify all outpatient claims / encounters with an asthma-related diagnostic code appearing in **any** position.

Procedures and laboratory

Referring to **Table ASTHMA-D3**, identify all claims / encounters with one of the asthma-related CPT, HCPCs, or ICD-9 procedure codes. These procedure codes will be used to identify asthma-related services during the measurement period, regardless of corresponding ICD-9 diagnosis codes.

Prescription drugs

Referring to **Table ASTHMA-D2**, identify medications by therapeutic class or generic/brand medication name or HCPC code during the measurement period.

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 asthma-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 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 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 ASTHMA-F below.

Table ASTHMA-F: 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.⁵
- Step 6** Calculate the DRG-specific per-diem payment rate by adjusting the standard daily prices for inflation to a reference year using the medical care component of 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.

Example⁶ 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 with an eligible ICD-9 code
- A DRG of XXX (DRG associated with an eligible inpatient stay for the

⁵ 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.

⁶ Figures presented in this example are arbitrary and do not reflect any particular dataset or patient. Additionally, the DRG XXX is intended to be used as an illustrative example for calculating inpatient costs. Only DRGs related to the episode should be included in this calculation.

episode)

- 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 with an eligible ICD-9 code
- A DRG of XXX (DRG associated with an eligible inpatient stay for the episode)
- Date of admission of December 28, 2006 and date of discharge of January 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. 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 for an eligible event assigned to 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 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

Assign patients to strata based on age at the beginning of the measurement year. Patients stratified into three mutually exclusive groups: 1) 5-12 years; 2) 13-50 years; 3) 51 years or older

Section 5 – Calculation of total individual episode costs

The resource use identified as asthma-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 asthma-related events occurring during the measurement year at the BETOS level. This will provide an estimate of the costs of each category of service over the measurement year.

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

Step 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 ASTHMA-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 ASTHMA-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 are the models selected for estimating adjusted costs in the asthma episode. Each was model 12 of the age specific analyses.

Risk Adjustment Model, Ages 5-12

Expected Costs = 1182+(Male*74)+(Age*-22)+(Major Depressive, Bipolar, and Paranoid Disorders *324)+(Opportunistic infections*1024)+(Lung, Upper Digestive Tract, and Other Severe Cancers *4770)+(Lymphatic, Head and Neck, Brain, and Other Major Cancers *505)+(End-Stage Liver Disease *3554)+(Pancreatic Disease *539)+(Inflammatory Bowel Disease *802)+(Rheumatoid Arthritis and Inflammatory Connective Tissue Disease *417)+(Severe Hematological Disorders *948)+(Disorders of Immunity *1051)+(Quadriplegia, Other Extensive Paralysis *1440)+(Paraplegia *1053)+(Spinal Cord Disorders/Injuries *544)+(Polyneuropathy *1549)+(Seizure Disorders and Convulsions *188)+(Respiratory Arrest *1422)+(Cardio-Respiratory Failure and Shock *962)+(Specified Heart Arrhythmias *642)+(Ischemic or Unspecified Stroke *1905)+(Cerebral Palsy and Other Paralytic Syndromes *759)+(Vascular Disease *784)+(Aspiration and Specified Bacterial Pneumonias *446)+(Pneumococcal Pneumonia, Emphysema, Lung Abscess *352)+(Decubitus Ulcer of Skin *1917)+(Hip Fracture/Dislocation *495)+(Artificial Openings for Feeding or Elimination *3331)

Risk Adjustment Model, Ages 13-50

Expected Costs = 677+(Male*-136)+(Age*22)+(Major Depressive, Bipolar, and Paranoid Disorders *1204)+(Chronic Obstructive Pulmonary Disease *730)+(Septicemia / Shock*1362)+(Opportunistic infections*608)+(Metastatic cancer and acute leukemia*963)+(Lung, Upper Digestive Tract, and Other Severe Cancers *260)+(Lymphatic, Head and Neck, Brain, and Other Major Cancers *363)+(Breast, Prostate, Colorectal and Other Cancers and Tumors *463)+(Diabetes with Neurologic or Other Specified Manifestation *136)+(Diabetes without Complication *2498)+(End-Stage Liver Disease *1203)+(Cirrhosis of Liver *1362)+(Intestinal Obstruction/Perforation *576)+(Pancreatic Disease *668)+(Inflammatory Bowel Disease *603)+(Bone/Joint/Muscle Infections/Necrosis *325)+(Rheumatoid Arthritis and Inflammatory Connective Tissue Disease *732)+(Severe Hematological Disorders *1071)+(Disorders of Immunity *1331)+(Schizophrenia *252)+(Quadriplegia, Other Extensive Paralysis *576)+(Spinal Cord Disorders/Injuries *309)+(Polyneuropathy *376)+(Multiple Sclerosis *288)+(Seizure Disorders and Convulsions *432)+(Respirator Dependence/Tracheostomy Status *2149)+(Respiratory Arrest *1220)+(Cardio-Respiratory Failure and Shock *1318)+(Unstable Angina and Other Acute Ischemic Heart Disease *396)+(Specified Heart Arrhythmias *431)+(Ischemic or Unspecified Stroke *589)+(Hemiplegia/Hemiparesis *1040)+(Cerebral Palsy and Other Paralytic Syndromes *1052)+(Vascular Disease with Complications *518)+(Vascular Disease *395)+(Pneumococcal Pneumonia, Emphysema, Lung Abscess *505)+(Renal Failure *382)+(Decubitus Ulcer of Skin *1240)+(Chronic Ulcer of Skin, Except Decubitus *661)+(Major Head Injury *307)+(Major Complications of Medical Care and Trauma

*554)+(Artificial Openings for Feeding or Elimination *719)+(Amputation Status, Lower Limb/Amputation Complications *1974)

Risk Adjustment Model, Ages 51-64

Expected Costs = 358+(Male*-136)+(Age*29)+(Major Depressive, Bipolar, and Paranoid Disorders *268)+(Chronic Obstructive Pulmonary Disease *571)+(Opportunistic infections*1161)+(Lung, Upper Digestive Tract, and Other Severe Cancers *835)+(Lymphatic, Head and Neck, Brain, and Other Major Cancers *337)+(Breast, Prostate, Colorectal and Other Cancers and Tumors *307)+(Pancreatic Disease *566)+(Inflammatory Bowel Disease *394)+(Bone/Joint/Muscle Infections/Necrosis *417)+(Rheumatoid Arthritis and Inflammatory Connective Tissue Disease *344)+(Disorders of Immunity *878)+(Spinal Cord Disorders/Injuries *507)+(Polyneuropathy *342)+(Seizure Disorders and Convulsions *306)+(Cardio-Respiratory Failure and Shock *536)+(Congestive Heart Failure *454)+(Specified Heart Arrhythmias *178)+(Vascular Disease with Complications *384)+(Chronic Ulcer of Skin, Except Decubitus *454)+(Major Complications of Medical Care and Trauma *383)

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

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.

Summary estimates of the average cost for asthma in the test episode:

\$1,590

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 \$2,250. Calculate the adjustment factor by dividing the costs from the current population by the average cost of \$1,590. That would result in an adjustment factor of 1.42. The adjustment factor is then applied to the estimated coefficients to provide an adjusted risk adjustment model.

Risk and Mean Adjusted Model

Risk and Mean Adjusted Asthma Episode Costs = 1.42 * Risk Adjusted Stable Asthma Episode Costs

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

Step 7 – Determination of attributable provider

Resource use and costs for asthma 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 codes occurring during the measurement year. 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 codes during the measurement year (“single attribution”); OR
2. If no provider has more than 70% of the E&M codes, costs and resource use are assigned to each of the providers that have at least 30% of the E&M codes for a patient during the measurement year (“multiple attribution”); OR
3. If no provider has at least 30% of the E&M codes during the measurement year, 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 ASTHMA-C**.

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 codes for each provider that had a claim for each of the patients:

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

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 Asthma Episode Provider Summary below for example)

**Asthma Episode
Provider Summary
Report for Physician
#XXXXXXX
Provider type = Internal
medicine**

	MD	Peer Group	Non-Peer Group	National Avg
Episodes	21	9512	68,434	77,967
Observed Costs*				
Average	\$ 897	\$ 992	\$ 1,481	\$ 1,421
Min	\$ 45	\$ 12	\$ 12	\$ 12
Median	\$ 747	\$ 538	\$ 853	\$ 807
Max	\$ 2797	\$ 11,140	\$ 11,140	\$ 11,140
Predicted Costs				
Average	\$ 1,400	\$ 1,083	\$ 1,523	\$ 1,470
Min	\$ 966	\$ 831	\$ 831	\$ 831
Median	\$ 1,126	\$ 1,039	\$ 1,502	\$ 1,392
Max	\$ 2,345	\$ 8,286	\$ 6,883	\$ 8,286
Observed-to-Expected Ratio				
Average	0.64	0.91	0.98	0.97
Min	0.03	0.01	0.01	0.01
Median	0.54	0.51	0.58	0.57
Max	1.54	13.40	13.40	13.40
% ≥ 2.0	0%	10.9%	11.6%	11.5%
% ≥ 2.5	0%	7.0%	7.7%	7.6%

* 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 asthma-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.⁷

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

Step 2: Combine BETOS codes with eligible events.

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.

⁷ https://www.cms.gov/HCPCSReleaseCodeSets/20_BETOS.asp

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 asthma-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
- For each type-of-service category for non-inpatient, non-pharmacy claims, summaries of the 20 CPT and HCPCs codes among non-asthma-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 asthma-related and non-asthma-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 asthma-related and non-asthma-related