

# NATIONAL QUALITY FORUM

## Resource Use Measure Evaluation 1.0 January 2011

This form contains the measure information submitted by stewards. Blank fields indicate no information was provided. Attachments also may have been submitted and are provided to reviewers. The subcriteria and most of the footnotes from the evaluation criteria are provided in Word comments within the form and will appear if your cursor is over the highlighted area. Hyperlinks to the evaluation criteria and ratings are provided in each section.

### Resource Use Definition:

- Resource use measures are broadly applicable and comparable measures of input counts—(in terms of units or dollars)-- applied to a population or population sample
- Resource use measures count the frequency of specific resources; these resource units may be monetized, as appropriate.
- The approach to monetizing resource use varies and often depends on the perspective of the measurer and those being measured. Monetizing resource use allows for the aggregation across resources.

**NQF Staff:** NQF staff will complete a preliminary review of the measure to ensure conditions are met and the form has been completed according to the developer's intent. Staff comments have been highlighted in green.

**TAP/Workgroup** (if utilized): Complete all yellow highlighted areas of the form. Evaluate the extent to which each subcriterion is met. Based on your evaluation, summarize the strengths and weaknesses in each section.

Note: If there is no TAP or workgroup, the SC also evaluates the subcriteria (yellow highlighted areas).

**Steering Committee:** Complete all pink highlighted areas of the form. Review the workgroup/TAP assessment of the subcriteria, noting any areas of disagreement; then evaluate the extent to which each major criterion is met; and finally, indicate your recommendation for the endorsement. Provide the rationale for your ratings.

### Evaluation ratings of the extent to which the subcriteria are met (TAP or Steering Committee)

**High (H)** - based on the information submitted, there is high confidence (or certainty) that the criterion is met

**Moderate (M)** - based on the information submitted, there is moderate confidence (or certainty) that the criterion is met

**Low (L)** - based on the information submitted, there is low confidence (or certainty) that the criterion is met

**Insufficient (I)** - there is insufficient information submitted to evaluate whether the criterion is met, e.g., blank, incomplete, or information is not relevant, responsive, or specific to the particular question (unacceptable)

**Not Applicable (NA)** - Not applicable (only an option for a few subcriteria as indicated)

### Evaluation ratings of whether the measure met the overall criterion (Steering Committee)

**Yes (Y)**- The overall criteria has been met

**No (N)**-The overall criterion has NOT been met

**High (H)** - There is high confidence (or certainty) that the criterion is met

**Moderate (M)** - There is moderate confidence (or certainty) that the criterion is met

**Low (L)** - There is low confidence (or certainty) that the criterion is met

### Recommendations for endorsement (Steering Committee)

**Yes (Y)** - The measure should be recommended for endorsement

**No (N)**-The measure should NOT be recommended for endorsement

**Abstain (A)**- Abstain from voting to recommend the measure

<b>TAP/Workgroup Reviewer Name:</b>
<b>Steering Committee Reviewer Name:</b>
<b>Staff Reviewer Name(s):</b>
<b>NQF Review #: 1588      NQF Project: Endorsing Resource Use Standards- Phase II</b>

BRIEF MEASURE INFORMATION
<b>Measure Title:</b> Episode of care for community acquired pneumonia hospitalization
<b>Measure Steward (IP Owner):</b> American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chicago, Illinois, 60601
<b>Brief description of measure:</b> Resource use and costs associated with management of adult episode following initial admission for community acquired pneumonia (CAP). The episode is defined to last 30 days from the day of admission to the hospital, and will also include the 3 days prior to hospital admission and will measure all pneumonia-related resource use. Attribution will occur at the level of the admitting hospital.
<b>Resource use service categories:</b> Inpatient services: Inpatient facility services Inpatient services: Evaluation and management Inpatient services: Procedures and surgeries Inpatient services: Imaging and diagnostic Inpatient services: Lab services Inpatient services: Admissions/discharges Ambulatory services: Outpatient facility services Ambulatory services: Emergency Department Ambulatory services: Pharmacy Ambulatory services: Evaluation and management Ambulatory services: Procedures and surgeries Ambulatory services: Imaging and diagnostic Ambulatory services: Lab services Durable Medical Equipment (DME)
<b>Brief description of measure clinical logic:</b> Resource use and costs associated with management of adult episode following initial admission for community acquired pneumonia (CAP). The episode is defined to last 30 days from the day of admission to the hospital, and will also include the 3 days prior to hospital admission and will measure all pneumonia-related resource use. Attribution will occur at the level of the admitting hospital.
<i>If included in a composite or paired with another measure, please identify composite or paired measure:</i>
<b>Subject/ Topic Areas:</b> Pulmonary/Critical Care
<b>Type of resource use measure:</b> Cost/Resource Use
<b>Data Type:</b> Administrative claims Other

CONDITIONS FOR CONSIDERATION BY NQF	
Four conditions must be met before proposed measures may be considered and evaluated for suitability as voluntary consensus standards:	NQF Staff
<b>A. Measure Steward Agreement.</b> <i>The measure is in the public domain or an intellectual property (<a href="#">measure steward agreement</a>) is signed. Public domain only applies to governmental organizations. All non-government organizations must sign a measure steward agreement even if measures are made publicly and freely available.</i>	A
<b>A.1. Do you attest that the measure steward holds intellectual property rights to the measure? (If no, do not submit)</b>	Y <input type="checkbox"/> N <input type="checkbox"/>

<p>Yes</p> <p>A.2. Please check if either of the following apply:</p> <p>A.3. Measure Steward Agreement.</p> <p>Agreement signed and submitted</p> <p>A.4. Measure Steward Agreement attached:</p> <p>Signed_NQFMeasureSteward Agreement_020309-634386972616419252.pdf</p>	
<p>B. Maintenance.</p> <p><i>The measure owner/steward verifies there is an identified responsible entity and process to maintain and update the measure on a schedule that is commensurate with the rate of clinical innovation, but at least every 3 years. (If no, do not submit)</i></p> <p>Yes, information provided in contact section</p>	<p>B</p> <p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>C. Purpose/ Use (All the purposes and/or uses for which the measure is specified and tested:</p> <p>Quality Improvement (Internal to the specific organization)</p>	<p>C</p> <p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>D. Testing.</p> <p><i>The measure is fully specified and tested for reliability <u>and</u> validity (<a href="#">See guidance on measure testing</a>).</i></p> <p>Yes, reliability and validity testing completed</p>	<p>D</p> <p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>E. Harmonization and Competing Measures.</p> <p><i>Have NQF-endorsed measures been reviewed to identify if there are related or competing measures? (List the NQF # and title in the section on related and competing measures)</i></p> <p>Yes</p> <p>E.1. Do you attest that measure harmonization issues with related measure (either the same measure focus or the same target population) have been considered and addresses as appropriate? (List the NQF # and title in the section on related and competing measures)</p> <p>No related measures</p> <p>E.2. Do you attest that competing measures (both the same measure focus and the same target population) have been considered and addressed where appropriate? No competing measures</p>	<p>E</p> <p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>F. Submission Complete.</p> <p><i>The requested measure submission information is complete and responsive to the questions so that all the information needed to evaluate all criteria is provided.</i></p>	<p>F</p> <p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>Have all conditions for consideration been met?</p> <p>Staff Notes to Steward (if submission returned):</p>	<p>Y <input type="checkbox"/></p> <p>N <input type="checkbox"/></p>
<p>Staff Notes to Reviewers (issues or questions regarding any criteria):</p>	
<p>File Attachments Related to Measure/Criteria:</p> <p>Attachment:</p> <p>Attachment: S5_Data Dictionary-634349351614077035.pdf</p>	

Attachment:  
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Attachment: 10.1\_Risk adjustment method-634349372878764535.pdf  
Attachment: SA\_Reliability\_VValidity Testing CAP Hospitalization.pdf

### IMPORTANCE TO MEASURE AND REPORT

Extent to which the specific measure focus is important to making significant gains in health care quality (safety, timeliness, effectiveness, efficiency, equity, patient-centeredness) and improving health outcomes for a specific high impact aspect of healthcare where there is variation in performance.

Importance to Measure and Report is a threshold criterion that must be met in order to recommend a measure for endorsement. All subcriteria must be met to pass this criterion.

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#### High Impact

#### IM1. Demonstrated high impact aspect of healthcare:

Affects large numbers

A leading cause of morbidity/mortality

#### IM1.1. Summary of evidence of high impact:

The Institute of Medicine and AQA have identified pneumonia as one of 20 conditions that should be considered priority areas in need of quality improvement based on its relevance to a significant volume of patients, its impact on those patients, and the perception of opportunity to significantly improve the quality and efficiency of related care. Pneumonia is a major cause of death worldwide and is the sixth most common cause of death in the US. (1, 2). Estimates of the annual incidence of community-acquired pneumonia (CAP) in the US range from 4-6 million cases annually (3, 4) and account for approximately 10 million physician visits per year (5). The economic burden is significant with estimates of total cost of care for CAP ranging from \$8 to over \$12 billion US annually (3-6). The average cost for an inpatient case is about \$5,700 and the average cost for an outpatient case is about \$300 (6).

Pneumonia is the second most common reason for hospitalization after childbirth (7). Approximately 20% of CAP patients require hospitalization, accounting for more than 1 million hospitalizations annually (5).

The mortality rate for pneumonia is less than 1% for CAP patients who do not require hospitalization, however it climbs to 8% to 28% among hospitalized patients with CAP, and the one year mortality rate may be as high as 40% in Medicare patients (1, 2, 8).

The rates of pneumonia are higher for men than for women and for black persons compared with Caucasians (9). The etiology of CAP, varies by geographic variation, however, *Streptococcus pneumoniae* is the most common cause of pneumonia worldwide. It is associated with considerable mortality and morbidity, especially in the elderly population and patients with significant comorbidities (4).

Nearly 80% of the treatment for this condition is provided in the outpatient setting. The majority of patients are treated out of hospital, however, the majority of cost (US \$8 billion) is attributed to patients admitted to the hospital (3).

Nationwide, nearly 75% of community-acquired pneumonia patients are initially evaluated and treated in hospital-based emergency departments (EDs) (10). The cost of inpatient care for pneumonia is up to 25 times greater than that of outpatient care (3). Studies have shown that patients at low risk for death who are treated in an outpatient setting are able to resume their normal activity sooner than those who are hospitalized, and 80% are reported to prefer outpatient therapy (11, 12). Hospitalization increases the risk of thromboembolic events and superinfection by more-virulent or resistant hospital bacteria (13). Overall, 6-15% of hospitalized patients with CAP do not respond to initial antibiotic treatment (14, 15).

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#### IM1.2. Citations for evidence of high impact cited in IM1.1.:

1. Niederman MS. Community-acquired pneumonia: the U.S. perspective. *Semin Respir Crit Care Med* 2009;30:179-188.
2. Mandell LA, Bartlett JG, Dowell SF, et al. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. *Clin Infect Dis* 2003;37:1405-33.
3. Niederman MS, McCombs JS, Unger AN, Kumar A, Popovian R. The cost of treating community-acquired pneumonia. *Clin Ther* 1998; 20: 820-37.
4. <http://www.ahrq.gov/clinic/pneumonia/pneumonria.htm> Accessed April 5, 2010.
5. Colice GL, Morley MA, Asche C, Birnbaum HG. Treatment costs of community-acquired pneumonia in an employed population. *Chest*. 2004 Jun;125(6):2140-5.
6. Lave JR, Lin CJ, Fine MJ, et al. The cost of treating patients with community-acquired pneumonia. *Semin Respir Crit Care Med* 1999; 20(3):189-97.
7. "Pneumonia Most Common Reason for Hospitalization." AHRQ. <http://www.ahrq.gov/news/nn/nn070208.htm>.
8. Restrepo MI, Mortensen EM, Velez JA et al. A comparative study of community acquired pneumonia patients admitted to the ward and the ICU. *Chest* 2008;133:610-7.
9. Marrie TJ. Epidemiology, pathogenesis, and microbiology of community-acquired pneumonia in adults. Up to date. [http://www.uptodate.com/contents/epidemiology-pathogenesis-and-microbiology-of-community-acquired-pneumonia-in-adults?source=see\\_link](http://www.uptodate.com/contents/epidemiology-pathogenesis-and-microbiology-of-community-acquired-pneumonia-in-adults?source=see_link)
10. Yealy DM, Auble TE, Stone RA, et al. The emergency department community-acquired pneumonia trial: Methodology of a quality improvement intervention. *Ann Emerg Med*. 2004 ;43:770-82.
11. Marrie TJ; Shariatzadeh MR. Community-acquired pneumonia requiring admission to an intensive care unit: a descriptive study. *Medicine (Baltimore)*. 2007 Mar; 86(2): 103-11.
12. Carratala J, Fernandez-Sabe N, Ortega L, et al. Outpatient care compared with hospitalization for community-acquired pneumonia: a randomized trial in low-risk patients. *Ann Intern Med* 2005; 142: 165-72.
13. Alikhan R, Cohen AT, Combe S, et al. Risk factors for venous thromboembolism in hospitalized patients with acute medical illness: analysis of the MEDENOX Study. *Arch Intern Med* 2004; 164:963-8.
14. Roson B, Carratala J, Fernandez-Sabe N, et al. Causes and factors associated with early failure in hospitalized patients with community-acquired pneumonia. *Arch Intern Med* 2004;164:502-8.
15. Menendez R, Torres A, Zalacain R, et al. Risk factors of treatment failure in community acquired pneumonia: implications for disease outcomes. *Thorax* 2004;59:960-5.

## IM2. Opportunity for Improvement

### IM2.1. Briefly explain the benefits envisioned by use of this measure:

To identify actionable information on the underlying causes of differences in patterns of care for care of community acquired pneumonia following hospitalization, it is useful to examine resource use and costs during an episode of care. If results from these analyses can provide clear and actionable information on which components of care can (or should) be reduced and which components of care can (or should) be increased, this information can help reduce spending while maintaining or even improving clinical quality and outcomes. This measure can be used to identify and, if necessary, address unwarranted variability in the resources used to treat pneumonia patients on an inpatient and, subsequently, outpatient basis, including potential follow-up hospitalizations. In addition where gaps in utilization occur leading to suboptimal quality, education and care coordination can be implemented.

### IM2.2. Summary of data demonstrating variation across providers or entities:

There is considerable documentation of regional and national variation in hospital admission rates and performance of processes of care considered "best practices" for the treatment of community-acquired pneumonia (1-12). Often there is no direct correlation between hospitalization and disease severity.

Approximately 10% of hospitalized patients with CAP require ICU admission (13-15) but the indications vary strikingly among patients, physicians, hospitals, and different health care systems. Some of the variability among institutions results from the availability of high-level monitoring or intermediate care units appropriate for patients at increased risk of complications. It is important to identify severe CAP requiring ICU care in order to optimize appropriate use of ICU sources and to avoid increased mortality due to delayed transfer to ICU (16).

--Switzer et al conducted a study to assess physician awareness and reported use of medical guidelines for community-acquired pneumonia (CAP), and to identify factors associated with variations in awareness and use of these guidelines. A questionnaire was administered during the preintervention phase of a randomized clinical trial of a pneumonia guideline implementation strategy involving 352 physicians who managed CAP. Results indicated low levels of awareness and use of guidelines for the management of CAP. Key indicators (e.g., medical specialty, fewer clinical duties, and positive

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attitudes about guidelines) were associated with greater use of national and local guidelines (17).

--Lindenauer et al, conducted a cross-sectional study using hospital and outpatient Medicare claims between 2006 and 2009 to describe patterns of hospital and regional performance in the outcomes of elderly patients with pneumonia examining hospital and regional level risk-standardized 30-day mortality and readmission rates. The investigators found risk-standardized 30-day mortality and, to a lesser extent, readmission rates for patients with pneumonia vary substantially across hospitals and regions and may present opportunities for quality improvement, especially at low performing institutions and areas (18).

--The Pneumonia Severity Index (PSI) has been put forth as an objective measure of risk stratification to help determine the initial site of treatment for patients with community-acquired pneumonia. Carratalà, et al conducted an unblinded, randomized controlled trial to determine whether outpatient care of PSI-defined low-risk patients with community-acquired pneumonia is as safe and effective as hospitalization. Patients received either outpatient care with oral levofloxacin therapy or hospitalization with sequential intravenous and oral levofloxacin therapy. Overall successful outcome was achieved in 83.6% of outpatients and 80.7% of hospitalized patients. More outpatients were satisfied with their overall care. Quality of life and the percentages of patients with adverse drug reactions, medical complications, subsequent hospital admissions, and overall mortality were similar in the outpatient and hospitalization groups (19).

--Skrepnek et al conducted a study to evaluate the resource consumption and outcomes associated with first line antibiotic treatment of community acquired pneumonia. Erythromycin, azithromycin, and clarithromycin were observed to have significantly lower total costs than levofloxacin although treatment success rates did not differ between groups (20).

### IM2.3. Citations for data on variation:

1. A Maryland Department of Health Mental Hygiene, Office of Policy Analysis and Program Evaluation, Division of Medical Practice Patterns Analysis: Variations in the use of medical and surgical services by the Maryland population. Rockville, Maryland Department of Health Mental Hygiene, 1986.
2. McMahon LF Jr; Wolfe RA; Tedeschi PJ. Variation in hospital admissions among small areas. A comparison of Maine and Michigan. *Med Care* 1989 Jun; 27(6): 623-31.
3. Meehan TP, Fine MJ, Krumholz HM, et al. Quality of care, process and outcomes in elderly patients with pneumonia. *JAMA*. 1997;278:2080-4. [PubMed]
4. McCormick D, Fine MJ, Coley CM, et al. Variation in length of hospital stay in patients with community-acquired pneumonia: are shorter stays associated with worse medical outcomes? *Am J Med*. 1999;107:5-12. [PubMed]
5. Fine MJ, Stone RA, Singer DE, et al. Processes and outcomes of care for patients with community-acquired pneumonia: results from the Pneumonia Patient Outcomes Research Team (PORT) Cohort Study. *Arch Intern Med*. 1999;159:970-80. [PubMed]
6. Gilbert K, Gleason P, Singer DE, et al. Variation in antimicrobial use and cost in more than 2,000 patients with community-acquired pneumonia. *Am J Med*. 1998;104:17-27. [PubMed]
7. Gleason PP, Kapoor WN, Stone RA, et al. Medical outcomes and antimicrobial costs with the use of the American Thoracic Guidelines for outpatients with community-acquired pneumonia. *JAMA*. 1997;278:32-9. [PubMed]
8. Weingarten S. Translating practice guidelines into patient care: guidelines at the bedside. *Chest*. 2000;118:4-7. [PubMed]
9. Roos NP, Wennberg JE, McPherson K. Using diagnosis-related groups for studying variations in hospital admissions. *Health Care Financ Rev*. 1988;9:53-62.
10. Wennberg JE, Freeman JL, Culp WJ. Are hospital services rationed in New Haven or over-utilised in Boston? *Lancet*. 1987;1:1185-1189.
11. Gilbert K, Fine MJ. Assessing prognosis and predicting patient outcomes in community-acquired pneumonia. *Semin Respir Infect*. 1994;9:140-152.
12. Dedier J, Singer DE, Chang Y, et al. Processes of care, illness severity, and outcomes in the management of community-acquired pneumonia at academic hospitals. *Arch Intern Med*. 2001;161:2099-2104.
13. Niederman MS, Bass JB, Campbell GD, et al. Guidelines for the initial management of adults with community-acquired pneumonia: diagnosis, assessment of severity, and initial antimicrobial therapy. American Thoracic Society. Medical Section of the American Lung Association. *Am Rev Respir Dis* 1993; 148:1418-26.
14. Roson B, Carratalà J, Dorca J, Casanova A, Manresa F, Gudiol F. Etiology, reasons for hospitalization, risk classes, and outcomes of community-acquired pneumonia in patients hospitalized on the basis of conventional admission criteria. *Clin Infect Dis* 2001; 33:158-65.
15. El Solh AA, Sikka P, Ramadan F, Davies J. Etiology of severe pneumonia in the very elderly. *Am J Respir Crit Care Med* 2001; 163: 645-51.



16. Leroy O, Santre C, Beuscart C, et al. A 7-year study of severe community-acquired pneumonia with emphasis on prognosis in patients admitted to an intensive care unit. *Intensive Care Med* 1995; 21:24–31.
17. Switzer GE, Halm EA, Chang CC, Mittman BS, Walsh MB, Fine MJ. Physician awareness and self-reported use of local and national guidelines for community-acquired pneumonia. *J Gen Intern Med*. 2003;18:816-23.
18. Lindenauer PK, Bernheim SM, Grady JN, et al. The performance of US hospitals as reflected in risk-standardized 30-day mortality and readmission rates for medicare beneficiaries with pneumonia. *J Hosp Med*. 2010;5:E12-8
19. Carratalà J, Fernández-Sabé N, Ortega L, et al. Outpatient care compared with hospitalization for community-acquired pneumonia: a randomized trial in low-risk patients. *Ann Intern Med*. 2005 Feb 1;142(3):165-7.
20. Skrepnek GH, Armstrong EP, Malone DC, Ramachandran S. An economic and outcomes assessment of first-line monotherapy in the treatment of community-acquired pneumonia within managed care. *Curr Med Res Opin* 2005;21:261-70.

#### IM2.4. Summary of data on disparities by population group:

There is some evidence of racial disparities in the treatment of community-acquired pneumonia. Studies have demonstrated African-American patients more likely to be re-admitted and are less likely to receive timely initiation of antibiotic therapy, diagnostic bronchoscopy, smoking cessation counseling, and pneumococcal and influenza vaccinations.

--Joynt et al. conducted a study to determine whether black patients have higher odds of readmission than white patients and whether these disparities are related to where black patients receive care. Using national Medicare data, they examined 30-day readmissions after hospitalization for acute myocardial infarction (MI), congestive heart failure (CHF), and pneumonia. The investigators found that among elderly Medicare recipients, black patients were more likely to be readmitted after hospitalization for the 3 common conditions, a gap that was related to both race and to the site where care was received (1).

--Mortensen et al conducted a review of Medicare beneficiaries hospitalized for pneumonia between 1998 and 1999. Significant findings were that blacks were less likely to receive antibiotics within 8 hours of admission (2).

--Bennett et al. conducted a retrospective chart review of Veterans Administration (VA) patients and non-VA patients with pneumocystis carinii pneumonia who were hospitalized from 1987 to 1990. Among non-VA patients, black and Hispanic patients were more likely to die in the hospital and less likely to undergo a diagnostic bronchoscopy in the first 2 days of hospitalization (3).

--Hausmann et al. conducted a retrospective cohort study of 1,183,753 non-Hispanic white, African American, and Hispanic adults hospitalized for pneumonia between January 2005 and June 2006 and found African American and Hispanic patients were less likely to receive pneumococcal and influenza vaccinations, smoking cessation counseling, and first dose of antibiotic within 4 hours than white patients at the same hospital (4).

--Hasan et al. conducted a retrospective database analysis of 154,381 adult discharges (age 18-64 years) with a principal diagnosis of acute myocardial infarction (AMI), stroke, or pneumonia from the 2005 Nationwide Inpatient Sample to determine whether there were insurance-related differences in hospital care. Compared with the privately insured, in-hospital mortality among pneumonia patients was significantly higher for Medicaid recipients. For pneumonia patients, LOS was consistently longer for Medicaid recipients and costs were significantly higher (5).

#### IM2.5. Citations for data on disparities cited in IM2.4:

1. Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. *JAMA*. 2011 Feb 16;305(7):675-81.
2. Mortensen EM, Cornell J, Whittle J: Racial variations in processes of care for patients with community-acquired pneumonia. *BMC Health Serv Res* 2004;4:20.
3. Bennett CL, Horner RD, Weinstein RA, et al. Racial differences in care among hospitalized patients with *Pneumocystis carinii* pneumonia in Chicago, New York, Los Angeles, Miami, and Raleigh-Durham. *Arch Intern Med* 1995;155:1586-1592.
4. Hausmann LR, Ibrahim SA, Mehrotra A, Nsa W, Bratzler DW, Mor MK, Fine MJ. Racial and ethnic disparities in pneumonia treatment and mortality. *Med Care* 2009;47:1009-1017.
5. Hasan O, Orav EJ, Hicks LS. Insurance status and hospital care for myocardial infarction, stroke and pneumonia. *Journal of Hospital Medicine* 2010;5:452–459.

#### IM3. Measure Intent

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<p><b>IM3.1. Describe intent of the measure and its components/ Rationale (including any citations) for analyzing variation in resource use in this way</b></p> <p>While documentation of regional variability in the overall costs of care reveals that inefficiencies exist in the healthcare system, it does not provide actionable information on the underlying causes of these differences or how they can be reduced. One potential solution is to focus on episode-based resource use and costs so that variations within a particular clinical area can be examined and areas of variability can be optimized. Moreover, episode-based resource measures can be combined with surrogate measures of quality care to identify highly efficient care where quality is high and costs are low. With this information, all parties involved (consumers, purchasers, and providers) can optimize treatment decisions that affect the balance of costs and quality of care.</p>	H <input type="checkbox"/> M <input type="checkbox"/> L <input type="checkbox"/> I <input type="checkbox"/>
<p><b>IM4. Resource use service categories are consistent with measure construct</b></p> <p><i>Refer to IM3.1. &amp; all S9 items to evaluate this criteria.</i></p>	1d  H <input type="checkbox"/> M <input type="checkbox"/> L <input type="checkbox"/> I <input type="checkbox"/>
<b>TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for <i>Importance to Measure and Report</i>?</b>	
<b>Steering Committee: Was the threshold criterion, <i>Importance to Measure and Report</i>, met?</b> <b>Rationale:</b>	Y <input type="checkbox"/> N <input type="checkbox"/>

### SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented.

### MEASURE SPECIFICATIONS

<p><b>S1. Measure Web Page:</b>  <i>Do you have a web page where current detailed measure specifications can be obtained?</i></p> <p>Yes  <a href="http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development">http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development</a></p> <p><b>S2. General Approach</b>  <i>If applicable, summarize the general approach or methodology to the measure specification. This is most relevant to measures that are part of or rely on the execution of a measure system or applies to multiple measures.</i></p> <p>The ABMS REF episode-based resource use measures were created in an open and transparent manner with input from a wide range of clinical experts, methodologists, health care economists and other stakeholders. The measure development process involved a series of deliberate steps where participating clinicians took into account the natural progression of a condition and existing best practices before carefully considering how to best use administrative claims data to construct the episode. They aimed to identify clinically homogenous populations so that the measures would be sensitive to provider decisions and existing practice protocols for like patients. Workgroup members were then asked to conceptualize the measure specifications based on their combined knowledge of guidelines, evidence, and clinical experience. The workgroups helped to define the denominator, duration, clinically relevant services and attribution of each episode as related to the clinical progression and treatment of the condition. Project staff then worked to translate the concepts into detailed written measure specifications and test the measures on a commercial database. The workgroups subsequently re-convened via a series of conference calls to review data analyses, share expert opinions, consider additional evidence-based literature, revise and finalize the measure specifications. Each measure was developed independently and, as such, they are not summative.</p>	<b>Eval Rating 2a1/2b1</b>
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Attachment:	
S3. Type of resource use measure:	
Per episode	
S4. Target Population:	
Adult/Elderly Care	
S4.1. Subject/Topic Areas:	
Pulmonary/Critical Care	
S4.2. Cross Cutting Areas (HHS or NPP National health goal/priority)	
Care Coordination	
S5. Data dictionary or code table Please provide a web page URL or attachment if exceeds 2 pages. NQF strongly prefers URLs. Attach documents only if they are not available on a web page and keep attached file to 5MB or less.	
Data Dictionary:	
URL:	
Please supply the username and password:	
Attachment: S5_Data Dictionary-634349351614077035.pdf	
Code Table:	
URL:	
Please supply the username and password:	
Attachment:	
S6.Data Protocol (Resource Use Measure Module 1) <i>The measure developer must determine which of the following data protocol steps: data preparation, data inclusion criteria, data exclusion criteria, and missing data, are submitted as measure specifications or as guidelines. Specifications limit user options and flexibility and must be strictly adhered to; whereas guidelines are well thought out guidance to users while allowing for user flexibility. If the measure developer determines that the requested specification approach is better suited as guidelines, please select and submit guidelines, otherwise specifications <u>must</u> be provided.</i>	
Data Protocol Supplemental Attachment or URL: <i>If needed, attach document that <u>supplements</u> information provided for data protocol for analysis, data inclusion criteria, data exclusion criteria, and missing data (Save file as: S6_Data Protocol). All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.</i>	
URL: <a href="http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development">http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development</a>	
Please supply the username and password:	
Attachment:	
S6.1. Data preparation for analysis <i>Detail (specify) the data preparation steps and provide rationale for this methodology.</i>	
Guidelines : Approach to Data Cleaning:	

If a standardized cleaning methodology or logic for the claims data exists, users are encouraged to apply the existing methodology, or conversely, encouraged not to remove data cleaning steps already implemented. If however, organizations impute missing data, we recommend using only non-imputed data.

Rationale: Each organization will be more familiar with the nature of their data therefore any standard cleaning procedures are likely to be appropriate. Imputation can produce unpredictable biases in the results.

#### S6.2. Data inclusion criteria

*Detail initial data inclusion criteria and rationale (related to claim-line or other data quality, data validation, e.g. truncation or removal of low or high dollar claim)*

Guidelines : Paid claims with non-missing enrollee identification numbers, primary procedure and diagnosis codes should be included in the measure.

Note: The ABMS REF resource use measures are constructed based on date of service, not date of payment. Therefore, we recommend applying the measures to finalized or “closed” datasets so that complete claims histories during the measurement period are captured in the data.

Including enrollees with at least 24 months of continuous medical and pharmacy benefit enrollment during the identification year and the measurement year is recommended. However, the measure has been tested on enrollees with at least 320 total days of coverage during each year. 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). This approach is based on the similar eligibility requirements used by NCQA for HEDIS measure denominators.

#### S6.3. Data exclusion criteria

*Detail initial data exclusion criteria and rationale (related to claim-line or other data quality, data validation, e.g. truncation or removal of low or high dollar claim)*

Guidelines : Beyond the standard data cleaning steps, we recommend that claim lines with missing or zero quantity values be set to a quantity of one and claim lines missing enrollee identification variables, primary diagnosis and procedure codes, and service date be eliminated. We also recommend eliminating all rejected or unpaid claims. Because a single provider id could have multiple specialties, we also recommend generating a uniform specialty for all providers by assigning each provider the specialty which is most frequently observed from all their Evaluation and Management visits.

Rationale: Converting missing or zero quantities to a minimum value of 1 allows for the pricing of these services. Claim lines missing enrollee identifiers, or primary procedure and diagnosis codes cannot be attributed to an individual, and without procedure and diagnosis codes, services cannot be properly identified and categorized. The resource use measures are intended to track costs to the payer, not general or societal costs, so rejected or unpaid claims should be eliminated.

Standardizing the specialty of all providers eliminates the possibility that providers are classified as one specialty for one enrollee and another specialty for others.

#### S6.4. Missing Data

*Detail steps associated with missing data and rationale (e.g., any statistical techniques used)*

Guidelines : Users are encouraged to eliminate claim lines missing enrollee identification variables or primary procedure and diagnosis codes. We do not recommend using any imputation methods to replace missing data.

Rationale: Claim lines missing enrollee identifiers cannot be attributed to an individual, and without procedure and diagnosis codes, services cannot be properly identified and categorized. Imputation of missing information could introduce bias into the measure, so we do not recommend the use of imputed data.

#### S7. Data Type: Administrative claims Other

##### S7.1. Data Source or Collection Instrument

*Identify the specific data source/data collection instrument (e.g. name of database, clinical registry, collection instrument, etc.)*

Sources for administrative claims: commercial databases

Standardized price tables: Users can download tables from the NCQA website (see url below) or use the guidelines in the technical appendix of the written measure specification to create their own standardized prices.

#### S7.2. Data Source or Collection Instrument Reference

*(Please provide a web page URL or attachment). NQF strongly prefers URLs. Attach documents only if they are not available on a web page and keep attached file to 5MB or less)*

URL: <http://www.ncqa.org/tabid/1092/Default.aspx>

Please supply the username and password:

Attachment:

#### S8.Measure Clinical Logic (Resource Use Measure Module 2)

*The measure's clinical logic includes the steps that identify the condition or event of interest and any clustering of diagnoses or procedures. For example, the diagnoses and procedures that qualifies for a cardiac heart failure episode, including any disease interaction, comorbid conditions, or hierarchical structure to the clinical logic of the model. (Some of the steps listed separately below may be embedded in the risk adjustment description, if so, please indicate NA and in the rationale space list 'see risk adjustment details.')*

#### Clinical Logic Supplemental Attachment or URL:

*If needed, provide a URL or document that supplements information provided for the clinical framework, co-morbid interactions, clinical hierarchies, clinical severity levels, and concurrency of clinical events*

URL: <http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development>

Please supply the username and password:

Attachment:

#### S8.1. Brief Description of Clinical Framework

*Briefly describe your clinical logic approach including clinical topic area, whether or not you account for comorbid and interactions, clinical hierarchies, clinical severity levels and concurrency of clinical events.*

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

#### S8.2. Clinical framework

*Detail any clustering and the assignment of codes, including the grouping methodology, the assignment algorithm, and relevant codes and rationale for these methodologies.*

The following steps were used to create the clinical framework for the measure.

Step 1: Identify patients that have a primary diagnostic code for a CAP Hospital admission during the event identification period (see Table CAP-A): Viral pneumonia: ICD9: 480.xx; Pneumococcal pneumonia: ICD9: 481.xx; Other bacterial pneumonia: ICD9: 482.xx; Pneumonia due to mycoplasma pneumonia: ICD9: 483.0; Pneumococcal pneumonia: ICD9: 483.1; Other bacterial pneumonia: ICD9: 483.8; Bronchopneumonia, organism unspecified: ICD9: 485.xx; Pneumonia, organism unspecified: ICD9: 486.xx; Influenza w. pneumonia: ICD9: 487.0; Ornithosis with pneumonia: ICD9: 073.0; Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia): ICD9: 041.3

OR a secondary diagnostic code for a CAP Hospital admission with a primary diagnosis of: Bacteremia: ICD9: 790.7; Empyema: ICD9: 510.xx; Unspecified pleural effusion: ICD9: 511.9; Septicemia: ICD9: 038.xx; Respiratory failure: ICD9: 518.81, 518.84

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

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

Step 3: Identify patients that meet one or more exclusion criteria during either the measurement period OR the prior year:

• Patient had ambulatory care diagnosis (see Table CAP-C2) for E&M ambulatory visit (see Table CAP-C3) between 4 days and 6 weeks prior to potential trigger ambulatory pneumonia visit: Diagnosis Codes: Viral pneumonia: ICD9: 480.xx; Pneumococcal pneumonia: ICD9: 481.xx; Other bacterial pneumonia: ICD9: 482.xx; Pneumonia due to mycoplasma pneumonia: ICD9: 483.0; Pneumococcal pneumonia: ICD9: 483.1; Other bacterial pneumonia: ICD9: 483.8; Bronchopneumonia, organism unspecified: ICD9: 485.xx; Pneumonia, organism unspecified: ICD9: 486.xx; Influenza w. pneumonia: ICD9: 487.0; Ornithosis with pneumonia: ICD9: 073.0; Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia): ICD9: 041.3

WITH Office or Other Outpatient Services: CPT: 99201–99215; Hospital Observation Services: CPT: 99217–99220; Hospital Inpatient Services: CPT: 99221–99239; Consultations: CPT: 99241–99275; Critical Care and Intensive Care Services: CPT: 99289–99298; Nursing Facility, Domiciliary and Home Services: CPT: 99301–99350; Case Management Services and Care Plan Oversight Services: CPT: 99361–99380; Preventive Medicine Services: CPT: 99381–99429; Other E&M Services: CPT: 99450–99456, 99354–99357

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

• Residence in nursing home within six months prior to trigger hospitalization (determined by ambulatory medical visit or nursing home claim at any time during six months prior to trigger admission – see Table CAP-C1).

• Hospice care during six months prior to trigger admission (determined by hospice claim any time during six month prior period – see Table CAP-C1).

• One or more of the following exclusion criteria during the identification OR the measurement year (see Tables PNEU-C4-C8): active cancer; ICD-9 Diagnosis: 140-171; 174-184; 187-203; 204.0; 204.2; 204.8; 205-208; 230-239 WITH CPT: 38230, 38240-38242, 77261-77799, 79000-79999, 96400-96549; ICD-9-CM Procedure: 41.0, 41.91, 92.2; UB Revenue 028x, 033x, 0342, 0344, 0973; end stage renal disease (ESRD) including renal dialysis: CPT36145, 36800-36821, 36831-36833, 90919-90921, 90923-90925, 90935, 90937, 90939, 90940, 90945, 90947, 90989, 90993, 90997, 90999, 99512; HCPCS: G0257, G0311-G0319, G0321-G0323, G0325-G0327, G0392, G0393, S9339; ICD-9-CM Diagnosis: 585.5, 585.6, V42.0, V45.1, V56; ICD-9-CM Procedure: 38.95, 39.27, 39.42, 39.43, 39.53, 39.93, 39.94, 39.95, 54.98; UB Revenue: 080x, 082x-085x, 088x ; UB Type of Bill: 72x; POS: 65; organ transplant: CPT: 32850-32856, 33930-33945, 44132-44137, 44715-44721, 47133-47147, 48160, 48550-48556, 50300-50380; HCPCS: S2152, S2053-S2055, S2060, S2061, S2065; ICD-9-CM Procedure: 33.5, 33.6, 37.5, 41.94, 46.97, 50.5, 52.8, 55.6; UB Revenue: 0362, 0367, 0810-0813, 0819; HIV/AIDS: ICD-9 Diagnosis: 042; cystic fibrosis: ICD-9 Diagnosis: 277.0x; lung cancer: ICD-9 Diagnosis: 162.x

Step 4: Combine prior steps to identify measure population

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

Eligible Event Identification

Eval  
Rating  
2a1

H ☐  
M ☐  
L ☐  
I ☐

Eval  
Rating  
2b1

H ☐  
M ☐  
L ☐  
I ☐

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

#### Inpatient hospitalization events

Identify all inpatient claims/ encounters with a CAP hospitalization-related diagnosis code appearing in the primary diagnosis field except where noted (see Table CAP-B3). Viral pneumonia: ICD9: 480.xx; Pneumococcal pneumonia: ICD9: 481.xx; Other bacterial pneumonia: ICD9: 482.xx; Pneumonia due to mycoplasma pneumonia: ICD9: 483.0; Pneumococcal pneumonia: ICD9: 483.1; Other bacterial pneumonia: ICD9: 483.8; Bronchopneumonia, organism unspecified: ICD9: 485.xx; Pneumonia, organism unspecified: ICD9: 486.xx; Influenza w. pneumonia: ICD9: 487.0; Ornithosis with pneumonia: ICD9: 073.0; Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia): ICD9: 041.3

OR a secondary diagnostic code for a CAP Hospital admission with a primary diagnosis of: Bacteremia: ICD9: 790.7; Empyema: ICD9: 510.xx; Unspecified pleural effusion: ICD9: 511.9; Septicemia: ICD9: 038.xx; Respiratory failure: ICD9: 518.81, 518.84

#### Outpatient events

Identify all outpatient claims / encounters with a CAP hospitalization-related diagnostic code appearing in any position (see Tables CAP-B1 and CAP-B2). Diagnostic codes: Viral pneumonia: ICD9: 480.xx; Pneumococcal pneumonia: ICD9: 481.xx; Other bacterial pneumonia: ICD9: 482.xx; Pneumonia due to mycoplasma pneumonia: ICD9: 483.0; Pneumococcal pneumonia: ICD9: 483.1; Other bacterial pneumonia: ICD9: 483.8; Bronchopneumonia, organism unspecified: ICD9: 485.xx; Pneumonia, organism unspecified: ICD9: 486.xx; Influenza w. pneumonia: ICD9: 487.0; Ornithosis with pneumonia: ICD9: 073.0; Friedlander's bacillus infection in conditions specified elsewhere and of Unspecified site (also as caused by kebsiella pneumonia): ICD9: 041.3; Chest Pain: ICD9: 786.50; Fever: ICD9: 780.6; Asthma, unsp: ICD9: 493.90; Status Asthmaticus: ICD9: 493.91; Asthma unsp w/acute exacerb.: ICD9: 493.92; Bronchitis, acute: ICD9: 466.0; Cough: ICD9: 786.2; Influenza, NOS: ICD9: 487.1; Pneumonia, unspecified: ICD9: 486; Upper respiratory infection, unsp. Site: ICD9: 465.9; Shortness of breath: ICD9: 786.05; Respiratory disease, unsp.: ICD9: 519.9; Wheezing (excludes asthma): ICD9: 786.07; Pleurisy: ICD9: 511.xx; Costochondritis: ICD9: 733.6; Clostridium-difficile: ICD9: 008.45  
X-Rays chest: CPT: 71010-71035; CT Chest: CPT: 71250, 71260, 71270; EKGs: CPT: 93000, 93005, 93010, 93040, 93041, 93042; Bronchoscopy: CPT: 31624, 31628; Inhalation Treatment: CPT: 94640; Decortization, pulmonary: CPT: 32220; Anesthesia-related procedures: CPT: 00541, 00520; Blood Count (CBC): CPT: 85025; Bronchodilation, spirometry: CPT: 94010, 94060; Non-invasive ear or pulse oximetry: CPT: 94760; Carbon-Monoxide diffusing capacity: CPT: 94720

#### Prescription drugs

Identify CAP hospitalization-related medications by therapeutic class or generic/brand medication name during the measurement period (see Table CAP-B4): Respiratory agents, Bronchodilators, Antibiotics, Anti-influenza meds (not antiretrovirals), Steroids – all, O2, Antihistamines, Cough medicines, Nebulizers, Anti-fungals. Do NOT include valacyclovir

#### S8.3. Comorbid and interactions

*Detail the treatment of co-morbidities & disease interactions and provide rationale for this methodology.*

See risk adjustment details—Section S10.1

#### S8.4. Clinical hierarchies

*Detail the hierarchy for codes or condition groups used and provide rationale for this methodology.*

We do not provide specifications for clinical hierarchies.

The only clinical hierarchies used in the measure are associated with the identification of comorbid conditions that are

used in risk adjustment. Details are provided in Section 10.1 of this submission form and in the risk adjustment section of the technical appendix in the written measure specification. In short, we use the CMS hierarchical condition categories (HCC) for assignment of comorbid conditions which utilizes a hierarchy of codes based on the ICD-9 codes present during the pre-index period. We rely on the HCC system for identifying comorbid conditions in our risk adjustment procedure. The hierarchies are important for our risk adjustment as they are intended to identify different levels of severity of conditions that may be differentially associated with resource use. We used the HCC system because it is a previously developed and validated system for use in resource use measures.

Within our episode measure there are no hierarchies assigned to any of the codes.

#### S8.5. Clinical severity levels

*Detail the method used for assigning severity level and provide rationale for this methodology.*

We do not provide specifications for clinical severity levels.

No severity level is defined for patients included in the episode. We attempt to create a relatively homogenous population through our inclusion and exclusion criteria.

#### S8.6. Concurrency of clinical events (that may lead to a distinct measure)

*Detail the method used for identifying concurrent clinical events, how to manage them, and provide the rationale for this methodology.*

We do not provide specifications for concurrency of clinical events.

Each of the measures developed as part of the ABMS measure set was intended as a standalone measure. The measures were not designed to be combined into a single composite measure of resource use for providers. Because the focus during the development of these measures was their eventual pairing with quality measures, each of the measures is considered as a unique measure. Therefore, the concurrency of events and the fact that events may be counted in more than one measure is not an issue. We were not trying to account for the overall resource use of a population but rather focused on resource use within specific cohorts of patients. The relative resource information produced is intended to result in actionable information which is not possible when all of the episodes are combined into a single composite measure.

#### S9. Measure Construction Logic (Resource Use Measure Module 3)

*The measure's construction logic includes steps used to cluster, group or assign claims beyond those associated with the measure's clinical logic. For example, any temporal or spatial (i.e., setting of care) parameters used to determine if a particular diagnosis or event qualifies for the measure of interest.*

Construction Logic Supplemental Attachment or URL:

*If needed, attach supplemental documentation (Save file as: S9\_Construction Logic). All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.)*

URL: <http://www.healthqualityalliance.org/hvhc-project/cost-care-measurement-development>

Please supply the username and password:

Attachment:

#### S9.1. Brief Description of Construction Logic

*Briefly describe the measure's construction logic.*

The following sequence is used to construct the measures:

1. Eligible population identification
2. Identification of related resources
3. Assignment of standardized prices
4. Creation of episode specific strata (if applicable)

#### S9.2. Construction Logic

*Detail logic steps used to cluster, group or assign claims beyond those associated with the measure's clinical logic.*



The episode is triggered by a hospital admission for CAP and ends post 30 days of trigger. The duration of the measurement period is the 30 days post admission as well as the 3 days prior to admission.

A minimum of 24 months of continuous data is necessary to calculate the measure.

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

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

The following steps are used to complete the construction sequence (for specific codes, see Section S8.2 clinical framework of this submission form as well as the written measure specification/technical appendix accessed via URL).

### ELIGIBLE POPULATION IDENTIFICATION

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

#### Step 1: Identify patients that meet episode inclusion criteria

Identify patients that have one of the diagnostic codes listed in Section S8.2 above for a CAP Hospital admission during the event identification period (see also Table CAP-A).

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

1. Age: Identify patients aged 18 and older.
2. Eligibility
  - a. Identify benefits during both the identification year and the measurement year. 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. (To be eligible, persons must have both medical and pharmacy coverage for the measurement period and prior period (do not include persons whose pharmacy benefits are dropped partway through the identification or measurement period).
  - b. Identify (or estimate) total days of coverage in each year. (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).
  - c. To be eligible, persons must have at least 320 total days of coverage during each year

#### Step 3: Identify patients with exclusion criteria

1. Identify patients that meet one or more exclusion criteria during either the measurement period OR the prior year

Exclusion criteria :

- Patient had ambulatory care diagnosis for E&M ambulatory visit between 4 days and 6 weeks prior to potential trigger ambulatory pneumonia visit (see codes described in Section S8.2 above or Tables CAP-2 and CAP-C3).
- Discharged from hospital after greater than 2-day stay for any reason within 90 days prior to trigger E&M visit or discharged within 90 days prior to trigger E&M (any LOS) with a CAP primary diagnosis (see codes described in Section S8.2 above or Table CAP-C1).
- Residence in nursing home within six months prior to trigger hospitalization (determined by ambulatory medical visit or nursing home claim at any time during six months prior to trigger admission – see codes described in Section S8.2 above or Table CAP-C1).

- Hospice care during six months prior to trigger admission (determined by hospice claim any time during six month prior period – see codes described in Section S8.2 above or Table CAP-C1).
- Active cancer treatment during measurement or prior period (see codes described in Section S8.2 above or Table CAP-C4).
- End stage renal disease (ESRD) during measurement or prior period (see codes described in Section S8.2 above or Table CAP-C5).
- Organ transplant during measurement or prior period (see codes described in Section S8.2 above or Table CAP-C6).
- HIV/AIDS during measurement or prior period (see codes described in Section S8.2 above or Table CAP-C7).
- Cystic fibrosis during measurement period or prior period (see codes described in Section S8.2 above or Table CAP-C8).
- Lung cancer during measurement or prior period (see codes described in Section S8.2 above or Table CAP-C8).

#### Step 4: Combine prior steps to identify measure population

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

#### ELIGIBLE EVENT IDENTIFICATION

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

##### Inpatient hospitalization events

Referring to the codes listed in Section S8.3 above, identify all inpatient claims/ encounters with a CAP hospitalization-related diagnosis code appearing in the primary diagnosis field except where noted (see also Table CAP-B3).

##### Outpatient events

Referring to the codes listed in Section S8.3 above, identify all outpatient claims / encounters with a CAP hospitalization-related diagnostic code appearing in any position (see also Tables CAP-B1 and CAP-B2).

##### Prescription drugs

Referring to the codes listed in Section S8.3 above, identify CAP hospitalization-related medications by therapeutic class or generic/brand medication name during the measurement period (see also Table CAP-B4).

#### ASSIGNMENT OF STANDARDIZED PRICES

Standardized prices are calculated for all of the components of care used to treat or manage the patient's condition to ensure that comparisons can be made solely on the basis of differential practice patterns and resource use. Three separate methodologies are used to derive these standardized prices: for inpatient facility charges, for ambulatory pharmacy charges (i.e., prescriptions dispensed outside the inpatient hospital setting), and for all other charges. These standardized prices are then applied to the claims identified as CAP hospitalization-related. For further details, see section S10.3 below.

#### CREATION OF EPISODE-SPECIFIC STRATA

Not applicable.

#### S9.3. Measure Trigger and End mechanisms

*Detail the measure's trigger and end mechanisms and provide rationale for this methodology.*

The episode is triggered by a hospital admission for CAP and ends post 30 days of trigger. The duration of the

measurement period is the 30 days post admission as well as the 3 days prior to admission.

Rationale: One month from hospitalization (plus three days prior) allows two major aspects of variation – LOS of initial stay and rehospitalizations within 30 day period from first admission – to be included in cost variation. The thirty day period was determined by the pneumonia workgroup to be sufficient period for resolution of the condition.

#### **S9.4.Measure redundancy or overlap**

*Detail how redundancy and overlap of measures can be addressed and provide rationale for this methodology.*

We do not provide specifications for measure redundancy or overlap.

To avoid redundancy within episodes of community acquired pneumonia (CAP), we have elected to create two distinct measures. One measure for ambulatory CAP and a separate measure for CAP with hospitalization. There is no overlap between these two measures.

Beyond CAP, the measures developed by ABMS REF were developed as standalone measures to address all relevant services associated with a particular health care condition. Collectively, the measures do not sum-up to a single total and there is the potential for overlap and redundancy to occur when multiple measures are applied simultaneously.

#### **S9.5.Complementary services**

*Detail how complementary services have been linked to the measure and provide rationale for this methodology.*

We do not provide specifications for linking complementary services.

All services included in the measure are included based on the presence of diagnosis codes, procedure codes, or medications.

Services are identified based on presence of qualifying codes. There is no effort to link complementary services to the episode. The strategy for all of our measures was to rely on the presence of codes to qualify for inclusion in the episode rather than to make assumptions about temporal or other associations between events.

#### **S9.6.Resource Use Service Categories**

Inpatient services: Inpatient facility services

Inpatient services: Evaluation and management

Inpatient services: Procedures and surgeries

Inpatient services: Imaging and diagnostic

Inpatient services: Lab services

Inpatient services: Admissions/discharges

Ambulatory services: Outpatient facility services

Ambulatory services: Emergency Department

Ambulatory services: Pharmacy

Ambulatory services: Evaluation and management

Ambulatory services: Procedures and surgeries

Ambulatory services: Imaging and diagnostic

Ambulatory services: Lab services

Durable Medical Equipment (DME)

#### **S9.7.Identification of Resource Use Service Categories**

*For each of the resource use service categories selected above, provide the rationale for their selection and detail the method or algorithms to identify resource units, including codes, logic and definitions.*

At the claim line level, the user should identify all relevant codes specified in the clinical framework Section 8.2 above (see also written measure specification). For inpatient services, these include all relevant ICD9, DRG v24, DRGv25, CPT codes; for ambulatory services, these include all relevant ICD9, and CPT codes; for procedures and laboratory

these include all relevant ICD9 procedure codes, HCPCs, and CPT codes, and for prescription drugs, these include relevant HCPCs and NDCs.

The above categories were selected because they represent the vast majority of resource use for the episode and the measure developers examined the distribution of costs between categories to evaluate the face validity of the measure. Developers also reasoned that resource use variation between providers by category would be informative. Please refer to Section S8.2 Clinical Framework for the algorithms used to identify/assign some services.

Measure developers also applied the Berenson-Eggers Types of Service (BETOS) system which categorizes all HCPCS codes into resource use areas (e.g. Evaluation and Management, Procedures, Imaging, etc). In addition to the BETOS category there is an additional category included for medications related resource use that is determined using pharmacy data and HCPCS.

Rationale: The BETOS classification system is a widely used, publically available system for classifying healthcare services. These categories can be used to examine cost patterns across providers to identify differences across the different categories of service. This system provides a sufficient number of categories to make meaningful comparisons across patterns of resource use and yet is not too broad so as not to be able to draw conclusions based on differences. Furthermore, identification of important differences allows users to drill down within those categories to identify cost drivers within BETOS categories that may ultimately provide actionable information for providers.

*If needed, provide specifications URL (preferred) or as an attachment:*

URL:

Please supply the username and password:

Attachment:

**S9.8. Care Setting; provides information on which care settings the measure encompasses.**

Ambulatory Care

Ambulatory Care : Ambulatory Surgery Center (ASC)

Ambulatory Care : Clinic/Urgent Care

Ambulatory Care : Clinician Office

Hospital/Acute Care Facility

Imaging Facility

Laboratory

Pharmacy

**S10.Adjustments for Comparability (Resource Use Measure Module 4)**

*External factors can mingle and affect or confound a measure's result. Confounding occurs if an extraneous factor causes or influences the outcome (e.g., higher resource use) and is associated with the exposure of interest (e.g., episode of diabetes with multiple co-morbidities). Measure developers often include steps to adjust the measure to increase comparability of results among providers, employers, and health plans.*

**S10.1. Risk adjustment method**

*Define risk adjustment variables and describe the conceptual, statistical, or other relevant aspects of the model and provide rationale for this methodology.*

See also the risk adjustment section in the technical appendix of the written measure specification.

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 (see Table CAP-RA1 in technical appendix of written measure specification), 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., heart failure for the CHF post hospitalization 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.

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

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

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

#### Risk Adjustment Model

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

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

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

following steps:

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

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

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

Summary estimates of the average cost for the CAP hospitalization episode in the test episode: Average Cost: \$14,839  
Example: To calculate the inflation factor, determine the average episode cost in the population to which the measure is being applied. As an example, the average cost might \$20,000. Calculate the adjustment factor by dividing the costs from the current population by the average costs of \$14,839. That would result in an adjustment factor of 1.35. The adjustment factor is then applied to the estimated coefficients for the adjusted risk adjustment model.

#### Risk Adjustment Model

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

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

#### Comorbidity Adjustment Strategy Rationale:

We acknowledge that risk adjustment is an important part of the development of an episode of care measure. Risk adjustment is intended to account for variation in episode costs that are not due to differences in practice patterns but rather are due to differences in the case mix of patients. When reporting episode costs at the provider level, risk adjustment attempts to account for differences in the case mix of patients across providers and minimizes the assertion that one providers patients are sicker than the comparator patients. An additional advantage of episode-based measurement is that focusing on costs related to care only for that episode may be a form of risk adjustment because we are not looking at the overall healthcare costs of the patients. Our risk adjustment strategy was not to attempt to account for all of the variation within an episode; however we want to be able to control for resource use variation that is attributed to the episode that may result from differences in patient case mix.

We selected to use Hierarchical Condition Categories (HCC) as our primary strategy for identification of comorbid conditions and for risk adjustment. We selected HCCs because of their use in risk adjustment methodology used by CMS and recently evaluated by NCQA for their Relative Resource Use (RRU) measures. We felt that many users of our episodes would be familiar with HCCs and the use of these measures in administrative data. Moreover, the analytic programmers for generating HCCs are freely available on the CMS website and therefore we mitigate issues of access to code for creating the risk adjustment groups.

While we use HCC as the starting point for our risk adjustment models, there is an important distinction between the use of HCCs by CMS and the model evaluated by NCQA and our episode definitions. The CMS and NCQA model use HCCs to adjust for TOTAL costs of care whereas, we are focused on the episode-specific costs of care. Briefly, NCQA has created weights for each of the HCCs on total costs of care using data from a large population that has one of the conditions in their RRU measure. These weights can then be applied to different populations to adjust for the presence of comorbid conditions when estimating total costs. The primary concern with applying the adjustment factors available from either CMS or NCQA are the fact they are total costs and not related to the episode-specific costs of care. This would lead to very different risk adjustment models that would not account for as much of the variability within the episode as a risk adjustment model focused on episode-specific costs. We compared the use of the 'off the shelf' HCC values with a risk adjustment model developed specifically for our episode.

See attached supplemental document for illustrative example of comparison of "off the shelf" HCC values to the risk adjustment model developed specifically for our episode (note: diabetes is used for purposes of illustration).



Given the disparity in the means and distributions of the off the shelf HCC values, we felt this justified our approach to develop risk adjustment models for each of our episodes that were focused on episode specific costs.

*If needed, provide supplemental information via a web URL (preferred) or attachment with the risk adjustment specifications.*

URL:

Please supply the username and password:

Attachment: 10.1\_Risk adjustment method-634349372878764535.pdf

### S10.2. Stratification Method

*Detail the stratification method including all variables, codes, logic or definitions required to stratify the measure and rationale for this methodology*

This method is not stratified.

### S10.3. Costing Method

*Detail the costing method including the source of cost information, steps to capture, apply or estimate cost information, and provide rationale for this methodology.*

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 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 (rejected or unadjudicated claims should be dropped). Categorize these claims as follows (in accordance with the BETOS classification process):

- 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 below.

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 (<http://www.ncqa.org/tabid/1092/Default.aspx>) for the corresponding measurement periods. Note that there is a one period lag in the file and data periods (i.e. files designated 2007 are based on 2006 data). Some periods may have two sets of tables if there is a significant change in DRG versions. Note: 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 wish to implement their own methodology that does not rely on a price list from NCQA.

Step 6 Calculate the DRG-specific per-diem payment rate by adjusting the standard daily prices for inflation to a reference period 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. (Note: 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).

Example:

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 February 2, 2007 and date of discharge of February 9, 2007 (fiscal period 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 period 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 (<http://www.ncqa.org/tabid/1092/Default.aspx>) 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 period 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 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 the measurement period beginning January 1, 2008)
- Prescriptions that may have been dispensed during the measurement period and had days supply that extended into the following period (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 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.

#### Example:

Assume that there are 3 non-inpatient-hospital, non-pharmacy claims during the measurement period with the following characteristics:

Patient: 1111, Procedure (CPT-4): 71010, Modifier: Date: 2/1/2007, Payment: \$21

Patient: 1111, Procedure (CPT-4): 72240, Modifier: TC, Date: 2/18/2007, Payment: \$90

Patient: 2222, Procedure (CPT-4): 71010, Modifier: Date: 1/5/2007, Payment: \$25

For the procedure/modifier combination: 71010

The total payment is  $\$21 + \$25 = \$46$

The total frequency is 2

Therefore the procedure/modifier-specific payment rate is  $\$46/2 = \$23$

For the procedure/modifier combination: 72240/TC

The total payment is \$90

The total frequency is 1

Therefore the procedure/modifier-specific payment rate is  $\$90/1 = \$90$

**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.

#### Calculation of total individual episode costs

The resource use identified as diabetes-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 diabetes-related events occurring during the measurement period at the BETOS service category 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 diabetes-related events to calculate

## TOTAL episode costs.

Step 3: Exclude individuals that do not have positive, non-zero costs (e.g. outpatient visit, hospitalization, medication use) during the measurement period.

### Rationale for costing method

We used standardized prices to estimate the costs for all components of care in the claims data that a patient received during the measurement period. Because costs in claims data reflect both the quantity and mix of services delivered as well as the prices paid for those services, some of the cost variation is due to price differences across providers (Thomas et al., 2005). Variations in cost data among organizations and over time can obscure real cost differences (Ritzwoller, et al., 2004) and impede comparisons across providers. To ensure that comparisons are made on the basis of differences in practice patterns and resource use, we developed standardized prices, such that a given service would have the same price across all providers (Thomas et al., 2005). We used separate methods to estimate standardized price that were used to calculate for inpatient facility costs, pharmacy costs, and cost for all other care.

For the inpatient facility use, we developed standardized prices using diagnosis-related group (DRG) information. For hospitalizations without DRG-level information, we used aggregate diagnostic service category (ADSC) level information. In each case, we adjusted for length-of-stay (LOS) during the measurement period so as to more closely mirror the payment systems typically applied among commercial health plans. Both approaches use relative resource use (RRU) HEDIS standardized daily price tables developed by NCQA. We worked in collaboration with NCQA in development of this methodology; however, users of the measure may need to implement their own methodology that does not rely on a price list from NCQA.

For pharmacy use, we determined the days supply for each medication that was dispensed during the measurement period identified by a unique national drug code (NDC). We calculated a standardized price per diem for each NDC in our data by dividing the total payments in the claims data by the total days supply in the claims data for that NDC. We then estimated patient's pharmacy costs by multiplying the standardized price per diem for each NDC by the patient's days supply during the measurement period for that NDC. Standardized prices for pharmacy was estimated using this approach rather than an average whole price (AWP) because the AWP is not defined by law or regulation and does not reflect discounts obtained by most purchasers. As a result, the ultimate price paid by purchasers is often significantly lower than the AWP (Pereira, 2005).

For all other use, we identify the primary procedure code (CPT, HCPCs, ICD-9, etc.) and the first modifier code for each service. We calculated a standardized price for each procedure/modifier by dividing the total procedure/modifier-specific payments by the frequency for each procedure/modifier combination in the claims data. We then applied this standardized price to each patient's procedure/modifier combination that occurred during the measurement period. This approach allowed for a consistent methodology to be applied to each procedure/modifier combination in the claims data to achieve the same price for a service across all providers.

### References:

Pereira BJG. Medicare Prescription Drug, Improvement and Modernization Act: Average Wholesale Price (AWP) Medscape Nephrology.2005;2(1)

Ritzwoller DP, Goodman MJ, Maciosek MV, Lafata JE, Meenan R, Hornbrook MC, Fishman PA. Creating Standard Cost Measures Across Integrated Health Care Delivery Systems. J Natl Cancer Inst Monogr 2005;35:80 – 87

Thomas JW, Grazier KL, Ward K. Economic Profiling of Primary Care Physicians: Consistency among Risk-Adjusted Measures. Health Services Research. 2004;39(4):985- 1004

## S11. Measure Reporting (Resource Use Measure Module 5)

*The measure developer must determine which of the following Measure Reporting functions: attribution approach, peer group, outliers and thresholds, sample size, and benchmarking and comparative estimates, are submitted as measure specifications or as guidelines. Specifications limit user options and flexibility and must be strictly adhered to; whereas guidelines are well thought out guidance to users while allowing for user flexibility. If the measure developer determines that the requested specification approach is better suited as guidelines, please select and submit guidelines, otherwise specifications must be provided.*

### S11.1. Detail attribution approach

*Detail the attribution rule(s) used for attributing costs to providers and rationale for this*

*methodology (e.g., a proportion of total measure cost or frequency of visits during the measure's measurement period) and provide rationale for this methodology.*

Resource use and costs are attributed to the hospital responsible for the trigger admission.

#### Rationale:

The attribution at the hospital level was found to be necessary given the limitations of administrative data. Among the possible attribution rules suggested by the pneumonia workgroup were attribution to admitting physician, potentially altered if discharge physician differed from admitting physician. We analyzed data to see if it were possible to identify a "pseudo" admitting physician, but this was not possible and the substantial number of physicians seen by a patient in the hospital made it impossible to assign a managing physician. Thus, after review of the data the workgroup decided that the measure was limited to attribution at the hospital level.

#### S11.2. Identify and define peer group

*Identify the peer group and detail how peer group is identified and provide rationale for this methodology*

Guidelines : Peer group consists of all non-federal general acute care hospitals. Given attribution at the hospital level, there is no need to define a special peer group other than to assure that hospitalizations are limited to non-federal acute care hospitals.

#### S11.3. Level of Analysis:

##### Facility

#### S11.4. Detail measure outliers or thresholds

*Detail any threshold or outlier rules and decisions based on measure resource use and provide rationale for this methodology*

Guidelines : Total observed episode costs are winsorized at the 2nd and 98th percentile, but claim line outliers are not removed and the use of risk adjusted results are intended to correct for any extreme outliers. The only exception is inpatient admissions. Extremely high admissions costs are winsorized at the 99th percentile ( i.e. any value higher than the 99th percentile are set to the 99th percentile cost).

Rationale: Winsorizing and risk adjustment limits the influence of outliers. Episodes with extremely high admission costs skews mean costs for the entire episode. Winsorizing admissions at the 99th percentile reduces this effect without eliminating information on the distribution of total episode costs.

#### S11.5. Detail sample size requirements

*Detail the sample size requirement including rules associated with the type of measure*

We do not provide specifications or guidelines for sample size requirements : The ABMS REF episode-based resource use measures do not randomly sample enrollees nor do we recommend that implementers construct measures from a random sample. Regarding the issue of sample size determination. It is well known that the nature of resource use measurement at the level of individual providers will often lead to unstable estimations. There have been a number of efforts to derive a single number for which such measures might be stable enough for comparison of providers or individual providers over time. Yet to date there is no commonly accepted minimum. At this time we have not attempted to derive a minimal sample size for measure use.

#### S11.6. Define benchmarking or comparative estimates

*Detail steps to produce benchmarking and comparative estimates and provide rationale for this methodology*

Guidelines : Creation of provider summaries

The provider summaries are a report of the resource use for an attributable unit (hospital or 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



(or ID for the attributable unit if at the hospital level), 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.

$$\text{O-to-E} = \text{Sum of Observed Costs} / \text{Expected Costs from Risk Adjustment Model}$$

Step 3: If applicable, create indicators for the strata the episodes fall into so that separate summaries can be created for each of the strata.

Step 4: Summarize the observed, expected and observed-to-expected ratio for each attributable provider. Report minimum, maximum, median and mean values of the observed-to-expected ratio for all episodes attributed to the provider.

Step 5: Summarize the observed, expected and observed-to-expected ratio for each provider type, overall, and within each strata (if applicable). Report summary statistics for each of the provider types so the data are summarized for all providers of the same type. For example, report the summary statistics for the observed-to-expected ratio for all of the family practice physicians to facilitate peer group comparisons.

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

Step 7: For each of the individual attributable units (hospital or provider), determine the proportion of O-to-E ratios that are greater than or equal to the 75th percentile of the O-to-E ratio for the peer group. Calculate the 95% confidence interval for the proportion. For example, if the provider for which summary statistics are being calculated is a general internist and it is Dr. Y, the 75th percentile of O-to-E ratios for all episodes attributable to general interests is determined. The proportion of Dr. Y's O-to-E ratio that are above the 75th percentile for all general interest episodes is determined and a 95% confidence interval is calculated for that proportion.

Step 8: Create provider summary reports for each attributable provider in the dataset

## S12.Type of Score:

Ratio

*If available, please provide a sample report:*

### S12.1. Interpretation of Score.

*(Classifies interpretation of score (s) according to whether higher or lower resource use amounts is associated with a higher or lower score, a score falling within a defined interval, or a passing score, etc)*

The summary score calculated for the measure is the ratio of the observed cost to the expected cost or the O-to-E ratio. The O-to-E ratio is calculated for each patient for the attributable provider and summary statistics are calculated for the O-to-E ratio. The O-to-E ratio provides an estimate of the observed cost for a patient to the expected cost based on the patient's mix of chronic conditions. Expected costs for each patient are the calculation of their risk adjusted costs. A value of 1 for the O-to-E ratio indicates that the observed costs are equal to the expected costs. A value greater than 1 indicates that observed costs are more than what would be expected based on the patient's mix of chronic conditions. A value less than 1 indicates that the observed costs are less than what would be expected based on the patient's mix of chronic conditions. Calculation of the O-to-E ratio incorporates our approach to risk adjustment by determining the expected costs from the risk adjustment model. A summary O-to-E ratio is calculated for each of the attributable providers which combines all the episodes for that provider. Summary statistics are calculated for each provider for the raw (unadjusted) costs for the episode, expected costs and the O-to-E ratio. Each summary measure includes minimum, maximum, median, and mean values.

### S12.2. Detail Score Estimation

***Detail steps to estimate measure score.*****Creation of provider summaries**

The provider summaries are a report of the resource use for an attributable unit (hospital or 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 (or ID for the attributable unit if at the hospital level), 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.

$$\text{O-to-E} = \text{Sum of Observed Costs} / \text{Expected Costs from Risk Adjustment Model}$$

Step 3: If applicable, create indicators for the strata the episodes fall into so that separate summaries can be created for each of the strata.

Step 4: Summarize the observed, expected and observed-to-expected ratio for each attributable provider. Report minimum, maximum, median and mean values of the observed-to-expected ratio for all episodes attributed to the provider.

Step 5: Summarize the observed, expected and observed-to-expected ratio for each provider type, overall, and within each strata (if applicable). Report summary statistics for each of the provider types so the data are summarized for all providers of the same type. For example, report the summary statistics for the observed-to-expected ratio for all of the family practice physicians to facilitate peer group comparisons.

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

Step 7: For each of the individual attributable units (hospital or provider), determine the proportion of O-to-E ratios that are greater than or equal to the 75th percentile of the O-to-E ratio for the peer group. Calculate the 95% confidence interval for the proportion. For example, if the provider for which summary statistics are being calculated is a general internist and it is Dr. Y, the 75th percentile of O-to-E ratios for all episodes attributable to general interests is determined. The proportion of Dr. Y's O-to-E ratio that are above the 75th percentile for all general interest episodes is determined and a 95% confidence interval is calculated for that proportion.

Step 8: Create provider summary reports for each attributable provider in the dataset

**S12.3. Describe discriminating results approach**

***Detail methods for discriminating differences (reporting with descriptive statistics--e.g., distribution, confidence intervals)***

Summary reports are generated at the attribution level that includes a summary estimate for the provider or hospital, the peer group, the non-peer group and the overall summary for the episode in the entire population. For each attributable provider / hospital the observed, expected and O-to-E ratio are summarized. The summaries are created to facilitate comparisons for the attributable provider or hospital with other providers in the same peer group and overall. The most meaningful comparisons are likely those between the provider or hospital and the peer group. Even though the results are risk adjusted, this may help to further balance the case mix or severity of the patients being compared. The summary statistics for the O-to-E ratios can be compared in order to provide a sense of the relative performance of the provider or hospital compared to peers. In addition, the proportion of O-to-E ratios about thresholds of 2.0 and 2.5 are provided for comparisons. Finally, for the attributable unit (hospital or provider) the proportion of O-to-E ratios that are greater than or equal to the 75th percentile of the O-to-E ratio for the peer group is determined and the 95% confidence interval calculated. The expectation would be that 25% of the estimates for the attributable provider would fall about this value if the distribution of O-to-E ratios is similar to the peer group. A statistically significant difference would be found between the groups if the 95% confidence interval did not include 25% in the range. For example, if the proportion at or above the 75th percentile of the peer group is 38% and the 95% confidence interval ranges from 28% to 48% then this provider would have significantly more O-to-E ratios at the upper end of the distribution than the peer providers. Alternatively, if the proportion at or above the 75th percentile was 8% and the 95% confidence interval ranged from 3% to 16% then the provider would have significantly fewer O-to-E ratios in the upper end of the distribution than the peer group. The 75th percentile in our testing was selected as an illustrative cut-point and it will be important to evaluate this threshold for comparing providers.

TESTING/ANALYSIS	
<p>Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. See guidance on measure testing.</p>	Eval Rating
<p>TESTING ATTACHMENT (5MB or less) or URL:</p> <p><i>If needed, attach <u>supplemental</u> documentation (Save file as: SA_Reliability_VValidity Testing) All fields of the submission form that are supplemented within the attachment must include a summary of important information included in the attachment and its intended purpose, including any references to page numbers, tables, text, etc.</i></p> <p>URL: Please supply the username and password: Attachment: SA_Reliability_VValidity Testing CAP Hospitalization.pdf</p>	
<p><b>SA1. Reliability Testing</b> <i>For each module tested or for the overall measure score:</i></p> <p><b>SA1.1. Data/sample</b> <i>(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)</i></p> <p>Thomson Reuter’s MarketScan Dataset was used in the testing of the ABMS REF episode-based resource use measures.</p> <p>The MarketScan Commercial Database provides a rich, comprehensive source of longitudinal administrative claims data, offering the largest convenience sample available in proprietary databases with over 30 million covered lives in each of the three most current years of data. The MarketScan Commercial Claims and Encounters (Commercial) Database is constructed from data contributed from over 100 medium and large size employers and health plans, representing over 130 unique carriers. The MarketScan Databases’ large sample size constitutes a nationally representative data sample of the U.S. population under the age of 65 with employer-sponsored health insurance.</p> <p>The stability of MarketScan data sources provides superior continuity of patients over multiple years, generally longer than other claims databases because the majority of the MarketScan data are sourced from large employers. As long as individuals remain with the same employer, they can be tracked across health plans.</p> <p>Features of the MarketScan Research Databases include:</p> <ul style="list-style-type: none"> <li>Fully paid and adjudicated claims including inpatient, outpatient, and prescription drug claims</li> <li>Complete payment/charge information, including amount of patient responsibility</li> <li>Validated diagnosis, procedure, and other standard codes on claims where applicable (CPT, ICD-9, DRG, NDC, etc)</li> <li>Demographic information on enrollees including age, gender, and geographic information (three-digit zip codes and MSA)</li> <li>Plan-type identifiers in the database include major medical, comprehensive, PPO, EPO, HMO, consumer-driven health plan, capitated or part-capitated POS and non capitated POS</li> <li>Standardized data elements and definitions, ensuring accurate comparisons</li> <li>Clinical data enhancements, such as Therapeutic Class and Generic Product Identifiers on drug records, and Major Diagnostic Categories and Diagnosis Related Groups on inpatient and outpatient records</li> <li>Case records linking all of the hospital, physician, and ancillary services provided during an inpatient stay, allowing for comparisons based on such statistics as average length of stay, cost per admission, etc.</li> </ul> <p>These data reflect the real world of treatment patterns and costs by tracking millions of patients as they travel through the healthcare system, offering detailed information about all aspects of care. Data from individual patients are integrated from all providers of care, maintaining all healthcare utilization and cost record connections at the patient level.</p>	<p>2a2</p> <p>H <input type="checkbox"/> M <input type="checkbox"/> L <input type="checkbox"/> I <input type="checkbox"/></p>

**SA1.2. Analytic Methods***(Describe method of reliability testing and rationale)*

Reliability refers to the reproducibility of results (Bannigan and Watson, 2009). To investigate the reliability of the measure, we examined the distribution of costs across categories of care (inpatient facility charge, evaluation and management, procedures, etc.) for all CAP hospitalization care episodes in the MarketScan data that met inclusion/exclusion criteria and for a subsample of this cohort. After applying inclusion criteria to the MarketScan data, we identified 48,530 admissions (see attached data summary Slide 4). This was reduced to 20,416 admissions after eliminating people lacking medical or pharmacy coverage over the prior and observation periods. After applying the exclusion criteria, there were 10,482 CAP admissions. For these 10,483 individual episodes, we examined the distribution of costs across categories of care for the entire cohort and the subsample as well as across geographic regions. We also used hospital identifiers to define variation across hospitals. Rationale: Our investigation of reliability allowed us to leverage on analyses that were being done to examine overall resource use and attribution of care.

Reference: Bannigan K, Watson R. Reliability and validity in a nutshell Journal of Clinical Nursing. 2009;18: 3237–3243

**SA1.3. Testing Results***(reliability statistics, assessment of adequacy in the context of norms for the test conducted)*

For all CAP hospital admission episodes of in the MarketScan data that met the inclusion/exclusion criteria (i.e., 10,483 episodes), inpatient hospital payments comprised the largest portion of costs, 84% of total payments (see attached data summary Slide 6), E&M payments (9% of total payments).

**SA1.4. Finding statement(s)—(i.e., is the measure deemed reliable, limitations identified)**

The results of our comparison would suggest that the measure could be deemed reliable.

**SA2. Validity Testing***For each module tested or for the overall measure score:***SA2.1. Data/Sample***(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)*

See section SA1.1 for description of Thomson Reuters MarketScan dataset

**SA2.2. Analytic Method***(Describe method of validity testing and rationale; if face validity, describe systematic assessment)*

Validity testing focused primarily on face validity. Initial testing included:

**Level 1 analyses**

- o Examined impact of inclusion/exclusion criteria on episode denominator
- o Examined total episode spending by type of service
- o Identified top 20 “condition-related” and “non-condition-related” E&M, procedures, imaging, tests, inpatient admissions (by ICD-9 and DRG) and drugs, by service counts and dollar volume
- o Tested proposed attribution logic, examined variability in per-episode resource use at individual provider level (as relevant) and by provider specialty.

**Level 2 analyses**

- o Incorporated risk adjustment
- o Produced sample physician-level reports in which observed-to-expected ratios are computed and the distribution of each physician’s episodes is compared to the peer group’s distribution.
- o Examined specific drivers of resource use variation
- o Examined variability in per-episode resource use across regions, states and the specialties of attributed providers.

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Throughout the process of empirically testing the measures, summary analyses were presented to the workgroups for review and discussion. The workgroups reviewed denominator attrition diagrams to assess how the measure's inclusion and exclusion criteria affected the episode's denominator. They also reviewed summaries of costs by type of service (inpatient hospital care, outpatient care, procedures, imaging, tests, and prescription drugs) and were asked to assess whether the distributions matched the clinical expectations for the condition's treatment. The clinicians were also presented with analyses of diagnosis and procedure level details in order to ensure that appropriate services were being captured and grouped to the episodes. At each step in the process, the measure specifications were revised based on workgroup feedback.

In addition to workgroup feedback results of the preliminary testing were also shared with a Technical Advisory Committee and the QASC Episodes Work Group and the measures revised according to feedback.

By presenting our results to the clinical workgroups and others to examine the distributions of resource use and costs to determine if these results meant their clinical expectations, we were able to access the face validity of our results.

### SA2.3. Testing Results

*(statistical results, assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment)*

We have developed a measure specification to measure resource use associated with a CAP hospitalization episode of care. The measure includes resource use related to management of pneumonia over a 30-day period in order to capture all pneumonia-related costs of treating these patients during the episode. This includes the initial hospitalization, any subsequent hospitalization days that fall within the 30-day episode, and ambulatory care following hospital discharge (and potentially during a three day period prior to the initial hospitalization). For the Level 1 analysis, we found that there were 10,483 episodes after applying our exclusion criteria (see attached data summary Slide 4). We found that the average total cost of a CAP hospitalization episode was \$14,882, and the predominating costs of the episode were due to the hospitalization payments (84% of the total costs). As part of the Level 2 analyses, we examined variability in per episode resource use by region and state. (see attached data summary Slides 19 and 20). It would be expected that hospital costs would be a large component of costs for these patients given the requirement of an initial hospitalization. The next category, evaluation and management (9% of total costs) will represent both inpatient and follow-up visits to physicians. These results were presented to the clinical workgroup who concurred that these results met their clinical expectations and had face validity.

### SA2.4. Finding statement(s)—(i.e., is the measure deemed reliable, limitations identified)

Based on the results of our investigations and concurrence from the clinical workgroup, our measure should be deemed to have face validity.

### SA3. Testing for Measure Exclusions

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#### SA3.1. Describe how the impact of exclusions (if specified) is transparent as required in the criteria

In the attached data summary, we have detailed how the exclusions impacted the resulting size of the cohort (see attached data summary Slide 4).

#### SA3.2. Data/sample for analysis of exclusions

*(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included)*

See section SA1.1 for description of Thomson Reuters MarketScan dataset.

#### SA3.3. Analytic Method

*(Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference)*

We examined the impact of several types of exclusions. In order to ensure that data are available for assessing the episode of care, we excluded individuals without continuous insurance coverage including medical and pharmacy benefits. We also excluded individuals who met standard NCQA exclusions for conditions that are resource intensive,

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which could potentially have a larger impact on resource use than the condition being studied (i.e., end stage renal disease, active cancer management, etc.) There were also exclusion criteria that were specified for this condition by the clinical workgroup: age < 18 years, hospitalization or nursing home stays or recent ambulatory treatment for pneumonia. In addition individuals with lung cancer and cystic fibrosis were excluded. We examined the impact of these exclusions on the resulting cohort size.

#### SA3.4. Results

*(statistical results for analysis of exclusions, e.g., frequency, variability, sensitivity analyses)*

The exclusion of individuals without continuous enrollment in health insurance with medical and pharmacy benefits reduced the sample by more than 50%. Among the 48,530 episodes that met the inclusion criteria for the measure, 20,416 or 42% remained after the continuous enrollment exclusion criteria were applied (see attached data summary Slide 4). Of these, 10,483 remained after implementing the other exclusion criteria. 8.8% of individuals were excluded because they were under 18 years of age.

#### SA3.5. Finding statement(s)-- *(i.e., is the measure deemed reliable, limitations identified)*

Based on the results of our analyses and feedback from the clinical workgroup, we would deem the measure to be reliable. Our investigation did find that a substantial portion of individuals were excluded due to the continuous enrollment criteria, which is related to the data itself rather than the clinical characteristics of the individuals.

#### SA4. Testing Population

*Which populations were included in the testing data? (Check all that apply)*

Commercial

#### SA5. Risk adjustment strategy

*Refer to items S10.1 and S10.2 to rate this criterion.*

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#### SA6. Data analysis and scoring methods

*Refer to items S12-S12.3 to rate this criterion.*

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#### SA7. Multiple data sources

*Refer to S7 & all SA1 items to evaluate this criterion.*

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#### SA6. Stratification of Disparities (if applicable)

*Refer to item S10.2 to rate this criterion.*

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**TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Scientific Acceptability of Measure Properties*?**



Steering Committee: Overall, was the criterion, <i>Scientific Acceptability of Measure Properties</i> , met? Rationale:	Y <input type="checkbox"/> N <input type="checkbox"/>
<b>USABILITY</b>	
Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making.	<b>Eval Rating</b>
<p>Meaningful, Understandable, and Useful Information</p> <p>U1. Current Use:</p> <p>Public reporting (disclosure to performance results to the public at large)          Quality improvement with external benchmarking</p> <p>U1.1. Use in Public Reporting Initiative Use in Public Reporting.  <i>Disclosure of performance results to the public at large (If used in a public reporting program, provide name of program(s), locations, Web page URL(s). If not publicly reported in a national or community program, state the plans to achieve public reporting, potential reporting programs or commitments, and timeline, e.g., within 3 years of endorsement)</i></p> <p>The ABMS REF has only recently completed the development and testing of its Episode-based Resource Use Measures. The Robert Wood Johnson Foundation (RWJF) has provided follow-up funding in the form of technical assistance to Aligning Forces for Quality communities for continued testing of the measures—a 15-month award to Brookings Institute with a subcontract to ABMS REF for continued field testing of select measures in up to four Aligning Forces for Quality (AF4Q) communities toward the goal of public reporting and quality improvement benchmarking.</p> <p>U1.2. Use in QI  <i>(If used in improvement programs, provide name of program(s), locations, Web page URL(s)).</i></p> <p>See section U1.1</p> <p>U1.3. Use for other Accountability Functions (payment, certification, accreditation)  <i>(If used in a public accountability program, provide name of program(s), locations, Web page URL(s)).</i></p> <p>See section U1.1</p>	<p style="text-align: center;">3a</p> <p style="text-align: right;">           H <input type="checkbox"/>            M <input type="checkbox"/>            L <input type="checkbox"/>            I <input type="checkbox"/> </p>
<p>U2. Testing of Interpretability  <i>(Provide a rationale for why the measure performance results are meaningful, understandable, and useful to the intended audience(s) for both public reporting and quality improvement).</i></p> <p>U2.1. If understanding or usefulness was demonstrated  <i>(e.g., through systematic feedback from users, focus group, cognitive testing, analysis of quality improvement initiatives) describe the data, methods, and results.</i></p> <p>The ABMS REF measures have not yet been tested for usefulness or interpretability. They are currently undergoing continued testing in up to four RWJF AF4Q communities.</p>	<p style="text-align: center;">3b</p> <p style="text-align: right;">           H <input type="checkbox"/>            M <input type="checkbox"/>            L <input type="checkbox"/>            NA <input type="checkbox"/> </p>
<p>U2.2. Resource use data and result can be decomposed for transparency and understanding.</p> <p>Refer to items S11 -S12.3.</p>	<p style="text-align: center;">3c</p> <p style="text-align: right;">           H <input type="checkbox"/>            M <input type="checkbox"/>            L <input type="checkbox"/>            I <input type="checkbox"/> </p>

<p>U3. If there are similar or related measures (either same measure focus or target population) measures (both the same measure focus and same target population), list the NQF # and title of all related and/or similar measures.</p> <p>U3.1. If this measure has EITHER the same measure focus OR the same target population as NQF-endorsed measure(s): Are the measure specifications completely harmonized?</p> <p>U3.2. If the measure specifications are not completely harmonized identify the differences, rationale, and impact on interpretability and data collection burden.  <i>Describe why this measure is superior to competing measures (e.g., a more valid or efficient way to measure quality); OR provide a rationale for the additive value of endorsing an additional measure. (Provide analyses when possible.)</i></p>	<p>3d</p> <p>H <input type="checkbox"/>  M <input type="checkbox"/>  L <input type="checkbox"/>  I <input type="checkbox"/>  NA <input type="checkbox"/></p>
<p>TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for <i>Usability</i>?</p>	
<p>Steering Committee: Overall, to what extent was the criterion, <i>Usability</i>, met?  Rationale:</p>	<p>H <input type="checkbox"/>  M <input type="checkbox"/>  L <input type="checkbox"/></p>
<p>FEASIBILITY</p>	
<p>Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement.</p>	<p>Eval Rating</p>
<p>F1. Data Elements Generated as Byproduct of Care Processes  <i>How are the data elements needed to compute measure scores generated? Data used in the measure are:</i></p> <p><i>Coded by someone other than person obtaining original information (e.g., DRG, ICD-9 codes on claims)</i></p>	<p>4a</p> <p>H <input type="checkbox"/>  M <input type="checkbox"/>  L <input type="checkbox"/>  I <input type="checkbox"/></p>
<p>F2. Electronic Sources  <i>Are the data elements needed for the measure as specified available electronically? (Elements that are needed to compute measure scores are in defined, computer-readable fields)</i></p> <p><i>ALL data elements in electronic claims</i></p> <p>F2.1. If ALL data elements are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using other than electronic sources.</p>	<p>4b</p> <p>H <input type="checkbox"/>  M <input type="checkbox"/>  L <input type="checkbox"/>  I <input type="checkbox"/></p>
<p>F3. Susceptibility to Inaccuracies, Errors, or Unintended Consequences  <i>Identify susceptibility to inaccuracies, errors, or unintended consequences of the measurement identified during testing and/or operational use and strategies to minimize or prevent. If audited, provide results.</i></p> <ul style="list-style-type: none"> <li>The majority of measures developed for this project are of 12 months duration or less with identification of the population in one year and measurement in the following. This resulted in eligibility criteria requiring a minimum of 24 months of continuous data (full medical and pharmacy benefit enrollment). Often, clinical workgroup members</li> </ul>	<p>4c</p> <p>H <input type="checkbox"/>  M <input type="checkbox"/>  L <input type="checkbox"/>  I <input type="checkbox"/></p>

expressed a desire to extend the duration of a measure to encompass more longitudinal clinical outcomes (e.g. cardiac complications for diabetes) however this was not practical due to the typical enrollment patterns in the commercial population.

- Sample size may be of concern for implementers seeking to measure resource use at the level of the individual provider. Many of the measures, when tested on commercial datasets, resulted in small sample sizes that may prohibit meaningful attribution. Discontinuous medical coverage and missing pharmacy coverage were responsible for significant (often greater than 50%) decreases in eligible populations, emphasizing the trade-offs between ensuring adequate sample size and achieving specificity/homogeneity in the measure denominator. If users are unable to achieve adequate sample size at the level of the individual provider, the measures specifications may still provide valuable information at the level of group, system or region.
- Administrative claims lack the detail necessary to fully understand appropriateness of resource use in relation to severity of disease (e.g. bundled hospital payments, absence of cancer staging information, absence of cardiac severity indicators, Type 1 v. Type 2 diabetes). Future efforts should consider the integration of administrative claims with other sources of clinical information such as registries and electronic health records.
- Resource use is only one component of efficiency measurement. The measures created in this project are not intended to be used in isolation to evaluate physician performance; rather they are intended to complement quality measures as an important component of performance evaluation.
- The measures developed in this project represent a small subset of clinical conditions, and do not address the full range of patient and provider experience. Each measure was developed independently and, as such, they are not summative. Efforts to sum multiple measures will result in double counting of services.
- The standardized pricing algorithms used for testing the measures were developed for use in the MarketScan dataset. The technical appendices accompanying the measures provide a guide to assist users in developing their own set of standardized prices unique to their datasets. Until a national list of standardized prices is made available to the general public, the methods employed in the testing phase of this project do not allow for national benchmarking.

#### F4. Data Collection Strategy

*Describe what you have learned/modified as a result of testing regarding barriers to operational use of the measure (e.g., availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, cost of proprietary measures).*

Administrative claims lack the detail necessary to fully understand appropriateness of resource use in relation to severity of disease (e.g. bundled hospital payments, absence of cancer staging information, absence of cardiac severity indicators, Type 1 v. Type 2 diabetes). Future efforts should consider the integration of administrative claims with other sources of clinical information such as registries and electronic health records.

There were several lessons learned throughout the development and testing of the ABMS REF episode-based resource use measures. First, was the importance of garnering a diverse range of clinical input in a transparent manner to foster face validity and acceptance in the clinical community. Second was the importance of adequate resources for data acquisition, preparation and analyses (time and personnel). Not all datasets are formatted the same which can lead to significant amounts of programmer time for re-formatting code or datasets. It is also important to allow 2-6 months lead time to negotiate data use agreements as use of health care data—even de-identified data—often involves complex contract negotiations.

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**TAP/Workgroup: What are the strengths and weaknesses in relation to the subcriteria for *Feasibility*?**

Steering Committee: Overall, to what extent was the criterion, *Feasibility*, met?  
Rationale:

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L ☐

#### RECOMMENDATION

Steering Committee: Do you recommend for endorsement?  
Comments:

Y ☐  
N ☐  
A ☐

#### CONTACT INFORMATION

**Co.1 Measure Steward (Intellectual Property Owner)**

**Co.1 Organization**

American Board of Medical Specialties Research and Education Foundation, 222 N. LaSalle St., Suite 1500, Chicago, Illinois, 60601

**Co.2 Point of Contact**

Kevin, Weiss, MD, [kweiss@abms.org](mailto:kweiss@abms.org), 312-436-2600-

**Measure Developer If different from Measure Steward****Co.3 Organization**

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**Co.4 Point of Contact**

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**Co.5 Submitter If different from Measure Steward POC**

Robin, Wagner, [rwagner@abms.org](mailto:rwagner@abms.org), 312-436-2605-, American Board of Medical Specialties Research and Education Foundation

**Co.6 Additional organizations that sponsored/participated in measure development**

Development of the ABMS REF Episode-based Resource Use Measures was supported by the Robert Wood Johnson Foundation under the High Value Healthcare Project: Characterizing Episodes and Costs of Care. Grant number 63609.

### ADDITIONAL INFORMATION

**Workgroup/Expert Panel involved in measure development**

**Ad.1** Provide a list of sponsoring organizations and workgroup/panel members' names and organizations. Describe the members' role in measure development.

**Community Acquired Pneumonia Hospitalization Workgroup Members**

William Dalsey, MD, American College of Emergency Physicians

Erika Ernst, MD, American College of Clinical Pharmacy

Thomas File, MD, Infectious Diseases Society of America

Lawrence Goodman, MD, American College of Radiology

Elizabeth Marlow, MD, Society of Hospital Medicine

Mark Metersky, MD, American College of Chest Physicians

Michael O'Dell, MD, American Academy of Family Physicians

Vincent Quagliarello, MD, American Geriatrics Society

Workgroups consisting of a panel of experts were assembled for each condition. In collaboration with the AMA PCPI, a formal call for nominations was issued to the PCPI membership. This process was supplemented with direct outreach to relevant organizations in an effort to achieve representation from a wide range of clinical expertise (medical, nursing, pharmacy, other allied health professionals). Workgroup members were selected based on their clinical knowledge and administrative experience—many also had significant experience in developing quality measures. Where possible, groups also included technical expertise from the health plan perspective.

The measure development process involved a series of deliberate steps where participating clinicians took into account the natural progression of a condition and existing best practices before carefully considering how to best use administrative claims data to construct the episode.

Each clinical workgroup initially convened for a two-day in-person meeting that began with an introduction to the concepts of episodes of care and resource use measurement-- including a review of the NQF framework for evaluating efficiency across episodes of care. The groups were then asked to conceptualize one or more episodes based on the phases of the NQF model. They aimed to identify clinically homogenous populations so that the measures would be sensitive to provider decisions and existing practice protocols for like patients. Workgroup members were then asked to conceptualize the measure specifications based on their combined knowledge of guidelines, evidence, and clinical experience. The workgroups helped to define the denominator, duration, clinically relevant services and attribution of each episode as related to the clinical progression and treatment of the condition.

Throughout the months following the in-person meeting, project staff then worked to translate the concepts into detailed written measure specifications. The workgroups subsequently re-convened via a series of conference calls to review data analyses, share expert opinions, consider additional evidence-based literature, revise and finalize the measure specifications.

#### Measure Developer/Steward Updates and Ongoing Maintenance

##### Ad.2 Year the measure was first released:

2010

##### Ad.3 Month and Year of most recent revision:

12, 2010

##### Ad.4 What is your frequency for review/update of this measure?

every 3 years

##### Ad.5 When is the next scheduled review/update for this measure?

12, 2013

##### Ad.6 Copyright statement/disclaimers:

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.

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##### Ad. 7 Date of Submission (MM/DD/YY):

04/21/2011



High-Value Health Care Project - Characterizing Episodes and Costs of Care (C3)  
Data Elements Required to Calculate C3 Measures

<b><u>Variable Name</u></b>	<b><u>Variable Description</u></b>	<b><u>Required Data Sources*</u></b>
admdate	Date of Admission	A
age	Age	E
billtyp	Facility Bill Type Code	C
days	Length of Stay	A
daysupp	Day's Supply	D
disdate	Date of Discharge	A
drg	Diagnosis related group	A,B
dstatus	Discharge status	A
egeoloc	Geographic Location	E
enrolid	Enrollee ID	All
fachdid	Facility Header Record ID	C
facprof	Professional/Facility Indicator	C
gennme	Generic Drug Name	D
mastfrm	Master Form Code	D
memdays	Member Days	E
ndcnum	National Drug Code (ndc_code in Redbook)	D
pay	Payment	A,B,C,D
pdx,dx1,dx2,...,dxn	Diagnosis Codes	A,B,C
physid	Physician ID	A,B
pproc, pproc1,..., pprocn	Procedure/Service Codes	A,B,C
procmod	Procedure Code Modifier	A,C
proctyp	Procedure Code Type	B,C
prodnme	Product Name	D
provid	Provider ID	A
qty	Quantity of Services	A,B,C,D
region	Region	E
revcode	Revenue Code	C
rx	Cohort Drug Indicator	D
sex	Gender	E
stdplac	Place of Service	C
stdprov	Provider Type	C
svcdat	Service Date	A,B,C,D
thercls	Therapeutic Class	D
tsvcdat	Date Service Ending	C

**Data Sources\***

- A. Administrative claims data – inpatient (facility)
- B. Administrative claims data – inpatient (professional)
- C. Administrative claims data – outpatient/ambulatory (professional and facility)
- D. Administrative claims data – pharmacy
- E. Enrollment/coverage data (2 or more years)

High-Value Health Care Project - Characterizing Episodes and Costs of Care (C3)  
Data Elements Required to Calculate C3 Measures

<b><u>Measure Component</u></b>	<b><u>Required Variables</u></b>
Standardized Prices*	enrolid, ndcnum, pay, qty, drg, pproc,...,pprocn.
Exclusions and standard coverage definition	enrolid, pdx,dx1,...,dxn, age, svcdte, pproc, pproc1,..., pprocn, pay, qty, revcode, memdays, rx, stdplac, proctyp.
Cohort Definition	enrolid, svcdte, pdx, pdx1,...,pdxn, pproc1,..., pprocn, pay, qty, sex, age, thercls, dstatus, stdplac, billtyp, fachdid, revcode.
Related Resource Use	enrolid, facprof, pay, qty, pproc1,..., pprocn, svcdte, admdte, disdate, pdx, dx1,..., dxn, drg, ndcnum, thercls, gennme, prodnme, daysupp, procmo, mastfrm.
Output and Attribution	enrolid, svcdte, standardized price variables*, BETOS**, pproc1,...,pprocn, pdx, dx1,...,dxn, egeoloc, region, provid, stdprov, age, sex, physid.

\* For internal testing and validation purposes, drug prices were calculated by taking the average of 2006 and 2007 Marketscan prices, inpatient facility prices were computed by calculating average daily price by DRG from 2007, and outpatient and service prices were constructed by calculating the mean price by procedure code within the Marketscan dataset.

\*\* Berenson-Eggers Type of Service – Categorizes Health Care Procedure Coding System (HCPCS) procedure codes in order to analyze health care expenditures. See link for full description.

[http://www.cms.hhs.gov/hcpcsreleasecodesets/20\\_betos.asp](http://www.cms.hhs.gov/hcpcsreleasecodesets/20_betos.asp)

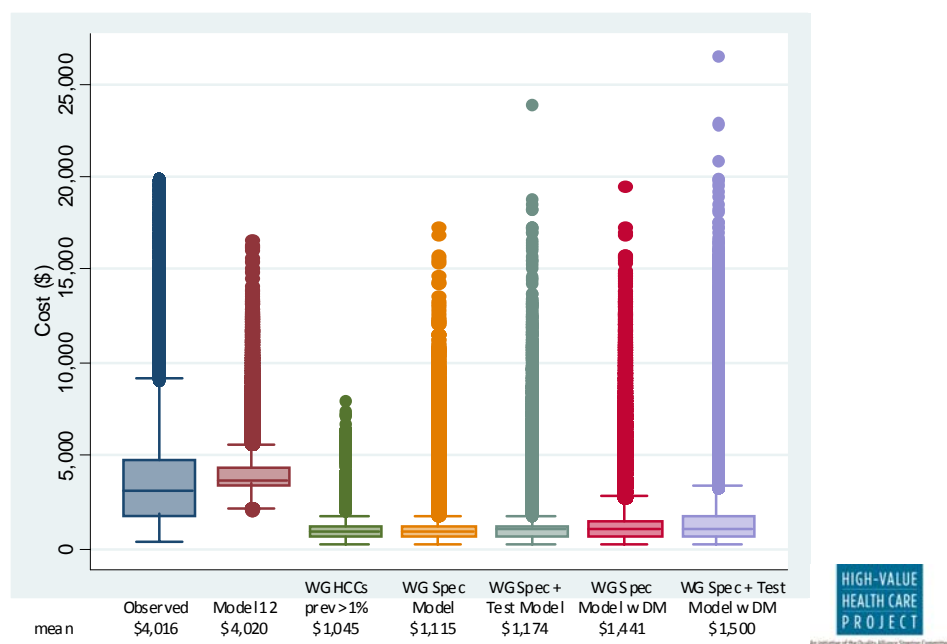
High-Value Health Care Project - Characterizing Episodes and Costs of Care (C3)  
Data Elements Required to Calculate C3 Measures

<b><u>Condition (Workgroup)</u></b>	<b><u>Measure Name</u></b>	<b><u>Abbreviation</u></b>
Acute Myocardial Infarction (AMI)	Episode-of-Care for 30 days Following Onset	AMI1
Acute Myocardial Infarction (AMI)	Episode-of-Care for Post-Acute Period (Days 31-365 Days Post-Event)	AMI2
Asthma	Episode-of-Care for Patients with Asthma over a 1-year Period	ASTH
Breast Cancer	Episode-of-Care for 60-Day Period Preceding Breast Biopsy	BB
Breast Cancer	Episode-of-Care for Treatment in Newly Diagnosed Cases of Breast Cancer over a 15-month Period	BCT
Chronic Obstructive Pulmonary Disease (COPD)	Episode-of-Care for Patients with Stable COPD over a 1-year Period	COPD1
Chronic Obstructive Pulmonary Disease (COPD)	Episode-of-Care for Patients with Unstable COPD over a 1-year Period	COPD2
Colon Cancer	Episode-of-Care for 21-Day Period Around Colonoscopy	COL
Colon Cancer	Episode-of-Care for Treatment of Localized Colon Cancer	CCT
Congestive Heart Failure (CHF)	Episode-of-Care for Management of CHF Over 1-Year Period	CHF1
Congestive Heart Failure (CHF)	Episode-of-Care for Post Hospitalization Management of CHF over 4-Month Period	CHF2
Coronary Artery Disease (CAD)	Episode-of-Care for Management of Chronic CAD Over 1-Year Period	CAD1
Coronary Artery Disease (CAD)	Episode-of-Care for Management of CAD Post Revascularization Over 1-Year Period	CAD2
Diabetes	Episode-of-Care for Diabetes Over 1-Year Period	DIAB
Low Back Pain	Episode-of-Care for Simple Non-Specific Lower Back Pain (Acute and Sub-Acute)	LBP1
Low Back Pain	Episode-of-Care for Acute/Sub-Acute Lumbar Radiculopathy With or Without Lower Back Pain	LBP2
Pneumonia	Episode-of-Care for Community-Acquired Pneumonia Hospitalization	PN1
Pneumonia	Episode-of-Care for Ambulatory Pneumonia Episode	PN2

## Comparison 'off the shelf' HCC Values with Episode-specific Risk Adjustment Model

Below we show the figure for the comparison of the diabetes risk adjustment model with diabetes risk adjustment models if we had used HCC values. The first box plot in the figure shows the observed costs in for the episode. The second box plot shows the risk adjustment model that we developed for our diabetes episode that is focused on diabetes-related costs. The final five box plots show the distribution of predicted costs including different HCCs for our diabetes episode if we had relied on the off the shelf HCC values. The mean predicted value for all of the off the shelf HCCs models is \$1500 or less, while the observed episode costs were slightly more than \$4,000. Given the disparity in the means and distributions of the off the shelf HCC values we felt this justified our approach to develop risk adjustment models for each of our episodes that were focused on episode specific costs

### Observed and Predicted Values – Diabetes Episode with “off the shelf HCCs”



12

For this reason, we have developed separate risk adjustment models for each of our episodes that are based on episode-specific costs. We realize this increases the complexity of implementing our measures; however, we feel it is a more appropriate approach for risk adjustment within our episodes. Within our risk adjustment approach, we control for different comorbidities for each condition because patients with each of the measurement conditions often had very different risk profiles.

We used the following risk adjustment strategy in the development of our risk adjustment 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 before the measurement year.

3. Tested 12 different model specifications shown in Table 1 (below), 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. This functional form of the model was selected as cost data are typically skewed and we wanted to account for that in the analysis. 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. We opted to include this functional form of the model so that the model output could be interpreted in dollars without requiring a transformation. We followed this strategy as we felt it would be easier for those implementing our measure to create their own risk adjustment models using this functional form of the model if they decided to create their own models. Finally, we opted to evaluate models that included all of the HCCs in case the work group may have failed to include HCCs that were influential on the overall episode costs. Model 9 used all of the HCCs, with the exception of the HCC for the episode being evaluated (e.g., diabetes for the diabetes episode; however HCCs for complications of diabetes were included), 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 1. Risk Adjustment Model Specifications**

Model #	Independent Variables						Distribution	Link function
	WG Specified (> 1%)	WG specified (> 1%) p < 0.1	Test condition s (> 1%)	Test condition s (> 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.





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# Analytic Findings: Community-Acquired Pneumonia Hospitalization Episode of Care

## NQF Submission

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# Overview of Analyses Presented for Pneumonia Episode\*

- Denominator Attrition
- Related and Non-related Services
- Resource Use, Attribution and
- Risk Adjustment

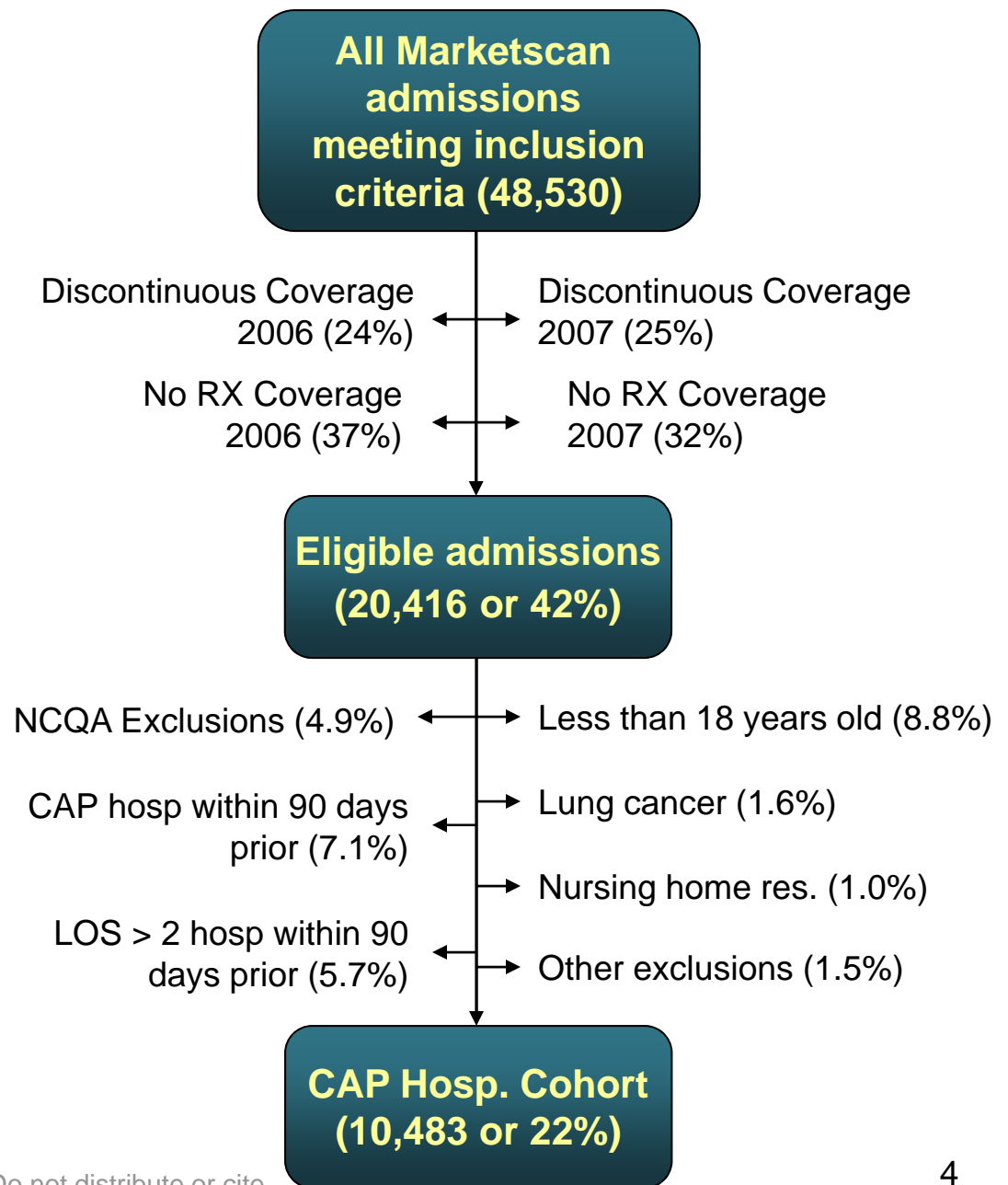
*\* The following results are based on the measure specification at different points in time, so the numbers are not always consistent, but they are not substantively different.*

# Denominator Attrition

- Summarizes the initial denominator based on the workgroup's specifications
- Describes the percentage of enrollees removed from the analysis due to NCQA exclusions or other criteria.

## CAP Hospitalization Measure Denominator

- Primary dx of pneumonia on hospital admission, or
- Primary dx of bacteremia, empyema, unspecified pleural effusion, septicemia, or respiratory failure on IP admission with pneumonia secondary
- Admission between 6/1/2006 and 10/2/2007
- Other Exclusions:
  - Cystic Fibrosis
  - Palliative care, hospice
  - Prior CAP dx on E&M claim 4 days to 6 weeks
- Note: exclusions are not additive (double-counting occurs often)



# Related and Non-Related Services

- Examines most frequent related and non-related resource use by BETOS category
  - Evaluation and Management Visits, Procedures, Imaging, Tests, Admissions and Medications.
- Results are presented to the workgroup to examine the face validity of episodes.

# Resource use by Type of Service, Community Acquired Pneumonia Hospitalization

Description	Mean	% of Total	5th %	25th %	50th %	75th %	95th %
Inpatient Facility	\$12,543	84%	\$4,452	\$6,021	\$8,040	\$12,512	\$34,485
Durable Medical Equipment	\$23	0%	\$0	\$0	\$0	\$0	\$153
OP Facility	\$82	1%	\$0	\$0	\$0	\$0	\$392
Imaging	\$282	2%	\$16	\$60	\$174	\$372	\$911
Evaluation and Management	\$1,365	9%	\$242	\$666	\$964	\$1,480	\$3,751
Other Services	\$106	1%	\$0	\$0	\$0	\$0	\$675
Procedures	\$325	2%	\$0	\$0	\$0	\$22	\$1,594
Tests	\$109	1%	\$0	\$0	\$27	\$111	\$468
Unclassified	\$30	0%	\$0	\$0	\$0	\$0	\$0
Drug Costs	\$17	0%	\$0	\$0	\$0	\$0	\$103
<b>Total Costs</b>	<b>\$14,882</b>	<b>100%</b>	<b>\$5,522</b>	<b>\$7,164</b>	<b>\$9,405</b>	<b>\$14,988</b>	<b>\$41,966</b>



# Pneumonia-related Inpatient Admissions, CAP Hospitalization Episode

- 84% of total episode costs

Primary Diagnosis	N	Amount
486 -Pneumonia, Organism NOS	49,577	\$318,017,423
51881-Acute Respiratory Failure	5,165	\$131,939,289
0389 -Septicemia NOS	3,929	\$92,755,907
51884-Acute & Chronic Resp Fail	1,105	\$31,531,372
03811-Staph Aureus Septicemia	562	\$20,343,068
48241-Staph Aureus Pneumonia	1,118	\$19,199,105
5109 -Empyema w/o Fistula	851	\$17,534,583
4821 -Pseudomonal Pneumonia	957	\$16,206,726
481 -Pneumococcal Pneumonia	1,643	\$14,326,899
0382 -Pneumococcal Septicemia	621	\$12,956,904
0380 -Streptococcal Septicemia	332	\$9,647,012
5119 -Pleural Effusion NOS	848	\$9,368,656
03849-Gram-Neg Septicemia NEC	313	\$8,466,384
03842-E Coli Septicemia	319	\$7,969,032
7907 -Bacteremia	435	\$7,844,030
Top 10	65,528	\$674,811,276
Total	75,140	\$790,087,398

CMS-DRG (2006)	N	Amount
089-SIMPLE PNEUMONIA & PLEURISY AG	13,336	\$103,662,434
576-Septicemia w/o MV 96+ hours w MCC	2,363	\$55,086,129
091-SIMPLE PNEUMONIA & PLEURISY AG	8,183	\$38,597,809
087-PULMONARY EDEMA & RESPIRATORY	1,447	\$30,013,162
565-Respiratory system diagnosis w ventilat	778	\$28,250,975
090-SIMPLE PNEUMONIA & PLEURISY AG	5,172	\$26,945,102
075-MAJOR CHEST PROCEDURES	763	\$25,295,699
076-OTHER RESP SYSTEM O.R. PROCED	840	\$24,472,947
578-Infectious & parasitic diseases w O.R. p	473	\$21,595,494
079-RESPIRATORY INFECTIONS & INFLA	978	\$16,529,313

MS-DRG (2007)	N	Amount
194-Simple pneumonia & pleurisy w CC	11,586	\$73,325,747
871-Septicemia w/o MV 96+ hours w MCC	2,602	\$61,007,886
195-Simple pneumonia & pleurisy w/o CC/M	11,837	\$55,625,791
193-Simple pneumonia & pleurisy w MCC	3,355	\$33,492,717
189-Pulmonary edema & respiratory failure	1,538	\$32,632,980
003-ECMO or trach w MV 96+ hrs or PDX exc	215	\$31,393,720
853-Infectious & parasitic diseases w O.R. p	504	\$25,855,339
207-Respiratory system diagnosis w ventilat	692	\$25,431,995
004-Trach w MV 96+ hrs or PDX exc face, m	256	\$24,684,461
163-Major chest procedures w MCC	676	\$21,811,986

# Pneumonia Non-related Inpatient Admissions, CAP Hospitalization Episode

Primary Diagnosis	N	Amount
V5789-Rehabilitation Proc NEC	1,012	\$24,698,187
4280 -Chf NOS	1,687	\$21,393,839
41401-Crnry AthrscI Natve Vssl	1,149	\$19,411,989
V5811-Antineoplastic Chemo Enc	1,142	\$16,579,403
49121-Obs Chr Bronc W(Ac) Exac	1,886	\$15,628,006
5070 -Food/Vomit Pneumonitis	828	\$12,738,376
99662-React-Oth Vasc Dev/Graft	568	\$9,794,417
5849 -Acute Renal Failure NOS	713	\$9,562,901
V3001-Single LB In-Hosp w Cs	505	\$8,925,007
20500-Act Myl Leuk wo Rmsion	161	\$8,122,572
20300-Mult Myelm wo Remission	248	\$8,044,080
2880 -Agranulocytosis	605	\$7,685,159
41071-Subendo Infarct, Initial	399	\$7,646,336
51883-Chronic Respiratory Fail	131	\$6,982,628
5185 -Post Traum Pulm Insuffic	107	\$6,665,938
<b>Top 10</b>	<b>9,651</b>	<b>\$146,854,697</b>
<b>Total</b>	<b>58,333</b>	<b>\$789,594,267</b>

CMS-DRG (2006)	N	Amount
541-ECMO OR TRACH W MV 96+HRS OR F	228	\$17,874,868
386-EXTREME IMMATURITY OR RESPIRA	160	\$13,618,739
088-CHRONIC OBSTRUCTIVE PULMONAF	1,561	\$13,126,352
481-BONE MARROW TRANSPLANT	103	\$12,687,169
075-MAJOR CHEST PROCEDURES	413	\$10,195,252
076-OTHER RESP SYSTEM O.R. PROCED	406	\$9,999,650
462-REHABILITATION	386	\$9,781,402
468-EXTENSIVE O.R. PROCEDURE UNRE	270	\$9,043,787
127-HEART FAILURE & SHOCK	887	\$8,271,596
144-OTHER CIRCULATORY SYSTEM DIA	509	\$7,462,836

MS-DRG (2007)	N	Amount
003-ECMO or trach w MV 96+ hrs or PDX exc	189	\$20,509,980
009-Bone marrow transplant	91	\$12,008,128
945-Rehabilitation w CC/MCC	494	\$11,675,084
004-Trach w MV 96+ hrs or PDX exc face, mc	95	\$7,999,097
166-Other resp system O.R. procedures w M	255	\$7,142,556
981-Extensive O.R. procedure unrelated to p	145	\$6,719,713
190-Chronic obstructive pulmonary disease	532	\$5,889,270
790-Extreme immaturity or respiratory distres	64	\$5,362,802
314-Other circulatory system diagnoses w M	284	\$4,861,112
291-Heart failure & shock w MCC	360	\$4,839,112

# Top 20, Pneumonia-related E&M, CAP Hospitalization Episode

- 9% of total episode costs

CPT	Svcs.	Cost	% of Svcs	% of Cost	Description
99232	32,415	\$2,591,014	31.3%	18.1%	Subsequent hospital care, per day
99233	16,295	\$1,881,769	15.7%	13.2%	Subsequent hospital care, per day
99222	3,390	\$1,588,602	3.3%	11.1%	Initial hospital care, per day
99291	4,752	\$1,541,994	4.6%	10.8%	Critical care, evaluation and management of the critically ill
99285	4,571	\$1,401,137	4.4%	9.8%	Emergency department visit
99223	5,729	\$1,153,986	5.5%	8.1%	Initial hospital care, per day
99254	3,762	\$679,267	3.6%	4.7%	Inpatient consultation for a new or established patient
99255	2,594	\$628,174	2.5%	4.4%	Inpatient consultation for a new or established patient
99238	5,725	\$511,236	5.5%	3.6%	Hospital discharge day management; 30 minutes or less
99231	7,290	\$390,691	7.0%	2.7%	Subsequent hospital care, per day
99213	4,826	\$367,610	4.7%	2.6%	Office or other outpatient visit, established patient
99239	2,847	\$356,793	2.7%	2.5%	Hospital discharge day management; more than 30 minutes
99214	2,803	\$271,258	2.7%	1.9%	Office or other outpatient visit, established patient
99284	1,070	\$218,910	1.0%	1.5%	Emergency department visit
99253	1,396	\$184,505	1.3%	1.3%	Inpatient consultation for a new or established patient
99292	465	\$108,546	0.4%	0.8%	Critical care, evaluation and management of the critically ill
99215	361	\$52,732	0.3%	0.4%	Office or other outpatient visit, established patient
99252	342	\$34,127	0.3%	0.2%	Inpatient consultation for a new or established patient
99221	313	\$33,253	0.3%	0.2%	Initial hospital care, per day
99283	252	\$32,446	0.2%	0.2%	Emergency department visit
Total	103,635	\$14,307,197	100.0%	100.0%	

# Pneumonia Non-related E&M, Top 20 ICD-9 Codes, CAP Hospitalization Episode

ICD-9 Code	Related	Not Related	Related Costs	Non-Related Costs
78609-Respiratory Abnorm NEC	896	416	\$146,911	\$69,837
496 -Chr Airway Obstruct NEC	1,470	692	\$181,478	\$67,733
49121-Obs Chr Bronc W(Ac) Exac	1,228	330	\$166,950	\$51,232
79902-Hypoxemia	1,010	244	\$157,952	\$45,806
25000-Dm II wo Cmp Nt St Uncntr	508	444	\$54,774	\$37,899
4280 -Chf NOS	696	291	\$85,960	\$37,782
42731-Atrial Fibrillation	869	230	\$93,489	\$28,765
4011 -Benign Hypertension	290	300	\$30,380	\$26,581
78659-Chest Pain NEC	240	128	\$41,701	\$24,021
78900-Abdmnal Pain Unspcf Site	204	162	\$29,627	\$23,287
4019 -Hypertension NOS	386	261	\$47,870	\$22,554
25002-Dm II wo Cmp Uncntrld	350	205	\$38,310	\$19,112
78079-Malaise & Fatigue NEC	105	149	\$20,283	\$18,806
78652-Painful Respiration	163	105	\$29,151	\$18,100
7802 -Syncope & Collapse	179	100	\$27,134	\$16,968
41401-Crnry Athrscld Natve Vssl	294	173	\$32,112	\$16,742
485 -Bronchopneumonia Org NOS	477	176	\$68,425	\$16,619
490 -Bronchitis NOS	132	146	\$18,032	\$14,559
27651-Dehydration	162	72	\$26,887	\$14,197
5849 -Acute Renal Failure NOS	821	120	\$97,582	\$13,552

# Top 20, Pneumonia-related Procedures, CAP Hospitalization Episode

- 2% of total episode costs

CPT	Svcs.	Cost	% of Svcs	% of Cost	Description
32220	148	\$262,531	1.8%	7.7%	Decortication, pulmonary (separate procedure); total
00542	155	\$259,538	1.9%	7.6%	Anesthesia for thoracotomy procedures
00541	105	\$176,084	1.3%	5.2%	Anesthesia for thoracotomy procedures; one lung ventilation
36556	401	\$110,461	5.0%	3.2%	Insertion of central venous catheter; age 5 years or older
31500	376	\$99,470	4.7%	2.9%	Intubation, endotracheal, emergency procedure
32652	48	\$90,128	0.6%	2.6%	Thoracoscopy, surgical; with total pulmonary decortication
00520	147	\$89,734	1.8%	2.6%	Anesthesia for closed chest procedures
31624	302	\$87,143	3.8%	2.6%	Bronchoscopy, with bronchial alveolar lavage
32020	241	\$85,517	3.0%	2.5%	Tube thoracostomy with or without water seal
00540	50	\$84,595	0.6%	2.5%	Anesthesia for thoracotomy procedures; NOS
31622	262	\$82,474	3.3%	2.4%	Bronchoscopy, with or without cell washing
00320	86	\$76,006	1.1%	2.2%	Anesthesia for all procedures on esophagus, thyroid, larynx
32320	35	\$63,953	0.4%	1.9%	Decortication and parietal pleurectomy
31628	162	\$60,023	2.0%	1.8%	Bronchoscopy, with transbronchial lung biopsy
00790	46	\$59,675	0.6%	1.7%	Anesthesia for intraperitoneal procedures in upper abdomen
32651	48	\$57,544	0.6%	1.7%	Thoracoscopy, surgical; with partial pulmonary decortication
32225	36	\$55,174	0.4%	1.6%	Decortication, pulmonary (separate procedure); partial
36569	205	\$48,117	2.6%	1.4%	Insertion of PICC, without subcutaneous port or pump
32000	290	\$48,110	3.6%	1.4%	Thoracentesis with insertion of tube with or without water seal
31600	86	\$47,195	1.1%	1.4%	Tracheostomy, planned
Total	8,021	\$3,410,273	100.0%	100.0%	

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# Common Pneumonia non-related Procedures, CAP Hospitalization Episode

CPT	Label	Related	Not Related	Related Costs	Non-Related Costs
43239	Upper gastrointestinal endoscopy including esophagus, stomach, and duodenum	110	73	\$33,221	\$22,380
00790	Anesthesia for intraperitoneal procedures in upper abdomen	46	36	\$59,675	\$21,696
00740	Anesthesia for upper gastrointestinal endoscopic procedure	67	35	\$38,410	\$17,130
36556	Insertion of non-tunneled centrally inserted central venous catheter	401	43	\$110,461	\$11,465
31500	Intubation, endotracheal, emergency procedure	375	49	\$99,193	\$10,013
00541	Anesthesia for thoracotomy procedures involving lungs, pleura, and mediastinal structures	105	7	\$176,084	\$9,673
31628	Bronchoscopy, rigid or flexible, with or without fluoroscopic guidance	162	20	\$60,023	\$7,735
00520	Anesthesia for closed chest procedures; (including bronchoscopy)	147	14	\$89,734	\$7,398
31624	Bronchoscopy, rigid or flexible, with or without fluoroscopic guidance	302	22	\$87,143	\$6,511
00540	Anesthesia for thoracotomy procedures involving lungs, pleura, and mediastinal structures	50	5	\$84,595	\$6,176
36569	Insertion of peripherally inserted central venous catheter (PICC)	205	19	\$48,117	\$4,587
32020	Tube thoracostomy with or without water seal for abscess, hematoma, or other collection	241	12	\$85,517	\$4,230
00320	Anesthesia for all procedures on esophagus, thyroid, larynx, and trachea	86	5	\$76,006	\$3,600
31622	Bronchoscopy, rigid or flexible, with or without fluoroscopic guidance	262	10	\$82,474	\$3,159
32320	Decortication and parietal pleurectomy	35	1	\$63,953	\$2,203

# Top 20, Pneumonia-related Imaging, CAP Hospitalization Episode

- 2% of total episode costs

CPT	Svcs.	Cost	% of Svcs	% of Cost	Description
71020	19,625	\$563,385	32.9%	19.0%	Radiologic examination, chest, two views, frontal and lateral
71260	2,928	\$392,611	4.9%	13.3%	Computed tomography, thorax; with contrast material(s)
71010	16,942	\$382,993	28.4%	12.9%	Radiologic examination, chest; single view, frontal
71275	1,175	\$192,036	2.0%	6.5%	Computed tomographic angiography, chest (noncoronary)
93307	1,992	\$177,594	3.3%	6.0%	Echocardiography, transthoracic; complete
71250	1,378	\$163,874	2.3%	5.5%	Computed tomography, thorax; without contrast material
93320	1,955	\$81,025	3.3%	2.7%	Doppler echocardiography, with spectral display
70450	734	\$77,058	1.2%	2.6%	Computed tomography, head or brain; without contrast
74160	534	\$64,466	0.9%	2.2%	Computed tomography, abdomen; with contrast material(s)
72193	575	\$64,320	1.0%	2.2%	Computed tomography, pelvis; with contrast material(s)
93970	746	\$52,917	1.3%	1.8%	Duplex scan of extremity veins; complete bilateral study
71270	283	\$46,589	0.5%	1.6%	Computed tomography, thorax; with and w/out contrast
78465	242	\$45,215	0.4%	1.5%	Myocardial perfusion imaging; tomographic (SPECT)
93325	1,864	\$39,371	3.1%	1.3%	Doppler echocardiography color flow velocity mapping
74150	309	\$33,107	0.5%	1.1%	Computed tomography, abdomen; without contrast material
72192	283	\$28,089	0.5%	0.9%	Computed tomography, pelvis; without contrast material
70486	259	\$26,477	0.4%	0.9%	Computed tomography, maxillofacial area; without contrast
76700	318	\$23,506	0.5%	0.8%	Ultrasound, abdominal, real time with image documentation
70553	105	\$22,606	0.2%	0.8%	Magnetic resonance (eg, proton) imaging, brain
76705	421	\$22,595	0.7%	0.8%	Ultrasound, abdominal, real time with image documentation
Total	59,574	\$2,957,673	100.0%	100.0%	

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# Common Pneumonia non-related Imaging, CAP Hospitalization Episode

CPT	Label	Related	Not Related	Related Costs	Non-Related Costs
93307	Echocardiography, transthoracic, real-time with image docu	1,991	424	\$177,512	\$61,388
70553	Magnetic resonance (eg, proton) imaging, brain (including b	105	62	\$22,606	\$35,741
78465	Myocardial perfusion imaging; tomographic (SPECT), multip	242	76	\$45,215	\$34,107
70450	Computed tomography, head or brain; without contrast mate	734	301	\$77,058	\$34,069
71275	Computed tomographic angiography, chest (noncoronary), v	1,173	126	\$191,742	\$32,131
74160	Computed tomography, abdomen; with contrast material(s)	534	177	\$64,466	\$31,054
93320	Doppler echocardiography, pulsed wave and/or continuous	1,954	434	\$80,988	\$28,403
72193	Computed tomography, pelvis; with contrast material(s)	575	173	\$64,320	\$26,691
93325	Doppler echocardiography color flow velocity mapping (List	1,863	426	\$39,356	\$24,840
74150	Computed tomography, abdomen; without contrast material	309	137	\$33,107	\$18,705
72192	Computed tomography, pelvis; without contrast material	283	128	\$28,089	\$17,634
93970	Duplex scan of extremity veins including responses to comp	746	150	\$52,917	\$16,570
74170	Computed tomography, abdomen; without contrast material,	165	64	\$21,656	\$14,250
70486	Computed tomography, maxillofacial area; without contrast r	259	63	\$26,477	\$10,860
76700	Ultrasound, abdominal, real time with image documentation;	318	92	\$23,506	\$9,885



# Pneumonia Provider Attribution

- Identify the provider or providers “responsible” for the patient’s care during the course of an episode
- Support a comparison across providers rather than simply across all episodes, which may be reflective of a normal distribution of costs population-wide

# Proposed Attribution Model

- Attribution of resource use and costs for an episode will take place at the level of the hospital.
- Episodes will be assigned to the hospital at which the admission occurs.
- The Marketscan database had low quality hospital ID, so attribution was not tested. Hospital attribution for CAP Pneumonia will be tested in future pilot testing.

# Identifying Variability in Pneumonia-specific Resource Use

- Analyses intended to identify trends in the observed variability in resource use for episodes of pneumonia management
- Variability measured at the following levels:
  - Region
  - State

# CAP Hospitalization: Mean Resource Use by Type of Service, All Episodes

Description	Mean	% of Total	5th %	25th %	50th %	75th %	95th %
All IP Facility Costs	\$12,526	84.4%	\$4,452	\$6,021	\$8,040	\$12,512	\$34,444
Readmissions	\$348	2.3%	\$0	\$0	\$0	\$0	\$0
Durable Medical Equipment	\$23	0.2%	\$0	\$0	\$0	\$0	\$152
OP Facility Costs	\$81	0.5%	\$0	\$0	\$0	\$0	\$388
Imaging	\$274	1.8%	\$16	\$59	\$171	\$359	\$885
Evaluation and Management - IP	\$0	0.0%	\$0	\$0	\$0	\$0	\$0
Evaluation and Management - OP	\$1,353	9.1%	\$211	\$656	\$959	\$1,471	\$3,736
Other Services	\$105	0.7%	\$0	\$0	\$0	\$0	\$675
Procedures	\$322	2.2%	\$0	\$0	\$0	\$22	\$1,558
Tests	\$108	0.7%	\$0	\$0	\$25	\$109	\$461
Unclassified	\$30	0.2%	\$0	\$0	\$0	\$0	\$0
Drug Costs	\$17	0.1%	\$0	\$0	\$0	\$0	\$104
<b>Total Costs</b>	<b>\$14,839</b>	<b>100.0%</b>	<b>\$5,509</b>	<b>\$7,151</b>	<b>\$9,387</b>	<b>\$14,937</b>	<b>\$41,897</b>

n = 10,645

# CAP Hospitalization: Resource Use by Type of Service vs. Overall Mean, by Region

Description	Mean	South	North Central	West	Northeast
N	10,645	5,177	3,192	1,384	835
All IP Facility	\$12,526	1.00	0.97	1.09	0.99
Readmits	\$348	1.03	1.10	0.88	0.70
DME	\$23	1.11	0.79	1.34	0.63
OP Facility	\$81	0.99	1.11	0.87	0.89
Imaging	\$274	1.04	1.00	0.89	0.95
E&M - IP	\$0	0.27	2.90	0.00	0.00
E&M - OP	\$1,353	0.99	0.98	1.06	1.08
Other	\$105	0.95	0.92	1.55	0.73
Procedures	\$322	0.93	0.90	1.37	1.24
Tests	\$108	1.19	0.84	0.76	0.81
Unclassified	\$30	0.85	0.80	1.67	1.54
Drugs	\$17	1.01	1.02	0.95	0.95
<b>Total</b>	<b>\$14,839</b>	<b>1.00</b>	<b>0.97</b>	<b>1.09</b>	<b>1.00</b>

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# CAP Hospitalization: Resource Use by Type of Service vs. Overall Mean, by State

Description	Mean	TX	MI	GA	CA	OH	TN	IL	IN	FL	MO
N	10,645	1,400	840	732	710	603	582	422	386	380	334
All IP Facility	\$12,526	0.95	1.02	0.99	1.13	1.00	1.03	0.83	1.01	1.06	0.92
Readmits	\$348	0.67	0.51	1.56	0.51	0.93	1.47	1.32	1.72	1.40	0.96
DME	\$23	1.02	0.47	1.68	0.58	0.47	0.92	1.09	0.74	2.42	0.86
OP Facility	\$81	1.76	0.40	0.30	0.38	1.34	0.91	1.43	1.79	0.77	1.54
Imaging	\$274	0.94	1.08	0.93	0.73	1.02	1.32	0.94	1.02	1.38	1.00
E&M - IP	\$0	0.00	9.94	0.00	0.00	0.00	2.37	0.00	2.38	0.00	0.00
E&M - OP	\$1,353	0.99	1.05	0.96	1.01	1.06	0.99	0.87	0.93	1.43	0.94
Other	\$105	1.03	0.87	0.95	0.94	0.94	0.91	0.78	0.47	1.19	1.75
Procedures	\$322	0.93	0.94	1.01	1.36	0.82	0.97	0.73	0.98	1.10	0.87
Tests	\$108	1.77	0.66	0.62	0.58	0.72	1.17	1.51	0.83	2.34	0.75
Unclassified	\$30	0.96	0.42	1.09	1.55	1.09	0.78	0.32	0.96	1.18	1.01
Drugs	\$17	1.15	0.89	0.92	0.92	0.89	1.05	0.92	1.55	0.91	0.97
<b>Total</b>	<b>\$14,839</b>	<b>0.97</b>	<b>1.01</b>	<b>0.98</b>	<b>1.11</b>	<b>1.00</b>	<b>1.03</b>	<b>0.84</b>	<b>1.01</b>	<b>1.11</b>	<b>0.93</b>

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# Risk Adjustment

- Testing of risk adjustment models
- Apply risk adjusted results to produce a provider specific summary report.

# Risk Adjustment Model Specification

- Test 12 different model specifications
  - Logged GLM model using gamma distribution
    - Full list of recommended comorbidities (> 1% prevalence)
    - Only recommended comorbidities that are statistically significant
    - Only recommended comorbidities that are statistically significant + additional comorbidities flagged for “empirical analysis” (all, significant only)
    - All HCCs & all statistically significant HCCs (regardless of prevalence)
  - Normal GLM model (estimates in dollars)
    - Same tweaks as above
- Fit models for the entire cohort



# Pneumonia Episode Risk Adjustment Matrix

Model #	Independent Variables						Distribution	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

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