Quality Payment
PROGRAM

Asthma/Chronic Obstructive Pulmonary Disease (COPD)

Measure Testing Form

Summer 2020 Field Testing

Contents

1.0 Introduction

This Measure Testing Form provides results for the testing of the Asthma/Chronic Obstructive Pulmonary Disease (COPD) measure that is being field tested between August 17 and September 18, 2020. Section 2 describes the scientific literature to support the measure as well as evidence of a performance gap among clinicians or clinician groups. Section 3 presents testing information and results for the measure.

The testing form accompanies the draft Measure Methodology document and draft Measure Codes List file posted on the MACRA Feedback Page,[1] which comprise the specifications for the Asthma/COPD measure.

1.1 Field Testing

1.1.1 Overview

As a part of the measure development process, field testing is an opportunity for clinicians and other stakeholders to learn about episode-based cost measures and provide input on the draft measure specifications. During field testing, Field Test Reports are distributed on the Quality Payment Program website[2] for group practices (identified by Tax Identification Number [TIN]) and individual clinicians (identified by combination of TIN and National Provider Identifier [NPI]) who meet the minimum number of cases for each measure. A volume threshold of 10 episodes was used for procedural and acute inpatient medical condition episode groups and 20 episodes for chronic condition episode groups (including Asthma/COPD). Draft measure specifications and supplemental documentation are available on the MACRA Feedback page.[3] Stakeholder feedback during field testing is collected on the draft specifications for each measure.

1.1.2 Providing Feedback

The feedback from field testing helps inform refinements to the measures before the Centers for Medicare & Medicaid Services (CMS) considers them for potential use in the Cost performance category of the Merit-based Incentive Payment System (MIPS). Acumen is collecting stakeholder feedback on the draft measure specifications of the 5 episode-based cost measures during the field testing period, between August 17 and September 18, 2020, through this online Field Testing Feedback Survey.[4]

Specific questions about the Asthma/COPD measure specifications are available in the Questions for Field Testing Measure Specifications document,[5] which stakeholders can use as a reference while reviewing the field testing materials.

[1] CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.
[2] CMS, "QPP Account," Quality Payment Program, https://qpp.cms.gov/login.
[3] CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.
[4] The field testing online survey will be open beginning August 17, 2020 at this link: https://www.surveymonkey.com/r/2020-cost-measures-field-testing.
[5] This document will be available on the MACRA Feedback Page once field testing begins. https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.

2.0 Measure Testing: Importance

2.1 Evidence to Support the Measure Focus

2.1.1 Measure Description

The Asthma/COPD cost measure evaluates a clinician's or clinician group's risk-adjusted cost to Medicare for patients receiving medical care to manage asthma or COPD. The measure score is a clinician's or clinician group's weighted average of risk-adjusted cost for each attributed episode, where each episode is weighted by the number of assigned days during the episode. This chronic measure includes services that are clinically related and under the reasonable influence of the attributed clinician or clinician group. Services are assigned during an Asthma/COPD episode, which is a portion of the overall time period of a clinician's or clinician group's responsibility for managing a patient's asthma or COPD. Medicare beneficiaries enrolled in Medicare Parts A and B during the performance period are eligible for the measure.

2.1.2 Evidence for Measure Focus

A recent study indicates that clinician beliefs about treatment and the efficacy of particular therapies may be the most important factors explaining the variation in health care expenditures.[6] However, clinicians are often unaware of how their care decisions influence the overall costs of care. Cost measures are intended to help inform clinicians on the costs associated with their decision-making and to incentivize cost-effective, high-quality care. A cost measure offers opportunity for improvement if clinicians can exercise influence on the intensity or frequency of a significant share of costs during the episode, or if clinicians can achieve lower spending and better care quality through changes in clinical practice.

According to the literature and feedback received through stakeholder input activities to date, this measure represents an area where there are opportunities for improvement. Various educational programs and interventions have been associated with reduced readmissions, hospitalizations, and complications among patients with asthma or COPD.[7,8] Opportunities to reduce costs and improve the chronic care and clinical outcomes of asthma or COPD exist primarily in maintenance pharmacotherapy, proper use of inhalers, pulmonary rehabilitation, and smoking cessation.

Advances in pharmacotherapy have led to the development of guidelines to improve the management and outcomes of patients with COPD.[9,10,11] However, it is estimated that 71% of

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[6] David Cutler et al., "Physician Beliefs and Patient Preferences: A New Look at Regional Variation in Health Care Spending," American Economic Journal: Economic Policy 11, no. 1 (February 1, 2019): 192–221. https://doi.org/10.1257/pol.20150421.

[7] Castro, Mario, Nina A. Zimmermann, Sue Crocker, Joseph Bradley, Charles Leven, and Kenneth B. Schechtman. "Asthma Intervention Program Prevents Readmissions in High Healthcare Users." American Journal of Respiratory and Critical Care Medicine 168, no. 9 (2003): 1095-99.

[8] Hussey, Peter S., Eric C. Schneider, Robert S. Rudin, D. Steven Fox, Julie Lai, and Craig Evan Pollack. "Continuity and the Costs of Care for Chronic Disease." JAMA Internal Medicine 174, no. 5 (2014): 742-48.

[9] Celli, Bartolome R., William MacNee, Alvar Agusti, Antonio Anzueto, B. Berg, A. Sonia Buist, Peter M. Calverley, et al. "Standards for the Diagnosis and Treatment of Patients with COPD: A Summary of the ATS/ERS Position Paper." European Respiratory Journal 23, no. 6 (2004): 932.

[10] National Collaborating Centre for Chronic Conditions. "Chronic Obstructive Pulmonary Disease. National Clinical Guideline on Management of Chronic Obstructive Pulmonary Disease in Adults in Primary and Secondary Care." Thorax 59 Suppl 1, no. Suppl 1 (2004): 1-232.

[11] Pauwels, Romain A., A. Sonia Buist, Peter M. Calverley, Christine R. Jenkins, and Suzanne S. Hurd. "Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease." American Journal of Respiratory and Critical Care Medicine 163, no. 5 (2001): 1256-76.

Medicare patients with COPD are not prescribed long-term maintenance pharmacotherapy.[12] Research has also shown other measures of under-treatment of COPD patients in the Medicare population, with suboptimal treatment for smoking cessation (behavioral therapy or prescriptions for medications), bronchodilator therapy post hospitalization, and pneumococcal and influenza vaccinations.[13] In addition to potential under-prescription, medication adherence has also been documented as suboptimal, with only 50% of Medicare patients adhering to medications, signaling that patients may not be benefiting from prescribed therapies.[14] This highlights an important opportunity for clinicians to prescribe treatment, such as appropriate inhaler devices, and encourage medication adherence during the management of COPD patients.

Current guidelines suggest that inhaled bronchodilators are the mainstay of COPD management and therapy,[15] and patients with either asthma or COPD can benefit from them.[16] However, research has shown that over 50% of patients with asthma or COPD do not handle inhaler devices as prescribed or instructed,[17] and up to 92% of patients experience critical errors that may impact the drug's effectiveness.[18] This has important implications as poor inhaler techniques and non-adherence to inhaled therapy limit the therapeutic benefit of medication for patients with asthma or COPD.[19,20] Existing literature suggests that the primary care physician has an important role in selecting appropriate inhaler devices for patients with asthma or COPD to optimize outcomes, while also encouraging patients to be involved in the decision-making process to improve patient education.[21] Promoting medication adherence and instructing patients on proper inhaler techniques through educational and training methods could facilitate a successful relationship between clinicians and patients and optimize health outcomes.[22]

Treatments that promote physical activity and exercise have been shown to improve patient outcomes for individuals with asthma or COPD.[23] Various studies have looked at different components of pulmonary rehabilitation treatments (i.e., intensity) and patient selection (i.e.,

[12] Make, Barry, Michael P. Dutro, Ryne Paulose-Ram, Jenö P. Marton, and Douglas W. Mapel. "Undertreatment of COPD: A Retrospective Analysis of Us Managed Care and Medicare Patients." International Journal of Chronic Obstructive Pulmonary Disease 7 (2012): 1-9.
[13] Ibid.
[14] Ibid.
[15] Guarascio, Anthony J., Shauntá M. Ray, Christopher K. Finch, and Timothy H. Self. "The Clinical and Economic Burden of Chronic Obstructive Pulmonary Disease in the USA." ClinicoEconomics and Outcomes Research 5 (2013): 235-45.
[16] Donohue, James F. "Therapeutic Responses in Asthma and COPD: Bronchodilators." CHEST 126, no. 2 (2004): 125S-37S.
[17] Molimard, Mathieu, Chantal Raherison, Severine Lignot, Aurelie Balestra, Stephanie Lamarque, Anais Chartier, Cecile Droz-Perroteau, et al. "Chronic Obstructive Pulmonary Disease Exacerbation and Inhaler Device Handling: Real-Life Assessment of 2935 Patients." 49, no. 2 (2017): 1601794.
[18] Chrystyn, Henry, Job van der Palen, Raj Sharma, Neil Barnes, Bruno Delafont, Anadi Mahajan, and Mike Thomas. "Device Errors in Asthma and COPD: Systematic Literature Review and Meta-Analysis." NPJ Primary Care Respiratory Medicine 27, no. 1 (2017): 22-22.
[19] Kaplan, Alan, and David Price. "Matching Inhaler Devices with Patients: The Role of the Primary Care Physician." Canadian Respiratory Journal 2018 (2018): 9473051-51.
[20] Dudvarski Ilic, Aleksandra, Vladimir Zugic, Biljana Zvezdin, Ivan Kopitovic, Ivan Cekerevac, Vojislav Cupurdija, Nela Perhoc, Vesna Veljkovic, and Aleksandra Barac. "Influence of Inhaler Technique on Asthma and COPD Control: A Multicenter Experience." International Journal of Chronic Obstructive Pulmonary Disease 11 (2016): 2509-17.
[21] Kaplan, Alan, and David Price. "Matching Inhaler Devices with Patients: The Role of the Primary Care Physician." Canadian Respiratory Journal 2018 (2018): 9473051-51.
[22] Sethi, Sanjay. "Effective Management of COPD in Primary Care: Challenges and Opportunities." American Journal of Managed Care (2018).
[23] Corbridge, Susan J., and Sharmilee M. Nyenhuis. "Promoting Physical Activity and Exercise in Patients with Asthma and Chronic Obstructive Pulmonary Disease." The Journal for Nurse Practitioners 13, no. 1 (2017): 41-46.

weight or disease severity) among COPD patients,[24,25,26,27] and have indicated the benefits of pulmonary rehabilitation in improving exercise capacity and muscle function. One study showed that comprehensive pulmonary rehabilitation programs are beneficial in both early and late stages of COPD.[28] For asthmatic patients, one study found that pulmonary rehabilitation can reduce the number of exacerbations and clinical visits while improving symptoms and pulmonary function.[29] A clinician's role in prescribing pulmonary rehabilitation has potential implications for cost savings and improved performance given the benefits of pulmonary rehabilitation.[30]

Smoking is a main causative factor for COPD.[31] Despite evidence showing the benefits of interventions promoting smoking cessation, it is estimated that 30 to 40% of COPD patients continue to smoke.[32] This is concerning given that COPD patients who smoke have a higher prevalence of respiratory symptoms and higher death rates compared to non-smokers.[33,34] Clinicians have an opportunity to promote smoking cessation among their patients in an effort to improve clinical outcomes and reduce cost of care. Existing literature suggests that smoking cessation among COPD patients is an important therapeutic intervention that "slows the accelerated rate of lung function decline and improves survival compared with continued smoking," even in severe COPD cases. [35] For asthmatic patients, smoking cessation improves

[24] Franssen, Frits M. E., Roelinka Broekhuizen, Paul P. Janssen, Emiel F. M. Wouters, and Annemie M. W. J. Schols. "Effects of Whole-Body Exercise Training on Body Composition and Functional Capacity in Normal-Weight Patients with COPD." CHEST 125, no. 6 (2004): 2021-28.
[25] Hsieh, Meng-Jer, Chou-Chin Lan, Ning-Hung Chen, Chung-Chi Huang, Yao-Kuang Wu, Hsio-Ying Cho, and Ying-Huang Tsai. "Effects of High-Intensity Exercise Training in a Pulmonary Rehabilitation Programme for Patients with Chronic Obstructive Pulmonary Disease." Respirology 12, no. 3 (2007): 381-88.
[26] Lan, Chou-Chin, Mei-Chen Yang, Chih-Hsin Lee, Yi-Chih Huang, Chun-Yao Huang, Kuo-Liang Huang, and Yao-Kuang Wu. "Pulmonary Rehabilitation Improves Exercise Capacity and Quality of Life in Underweight Patients with Chronic Obstructive Pulmonary Disease." Respirology 16, no. 2 (2011): 276-83.
[27] Ngaage, Dumbor L., Kirsteen Hasney, and Micheal E. Cowen. "The Functional Impact of an Individualized, Graded, Outpatient Pulmonary Rehabilitation in End-Stage Chronic Obstructive Pulmonary Disease." Heart & Lung: The Journal of Cardiopulmonary and Acute Care 33, no. 6 (2004): 381-89.
[28] Ergün, Pinar, Dicle Kaymaz, Ersin Günay, Yurdanur Erdoğan, Ulkü Yilmaz Turay, Neşe Demir, Ebru Canak, et al. "Comprehensive out-Patient Pulmonary Rehabilitation: Treatment Outcomes in Early and Late Stages of Chronic Obstructive Pulmonary Disease." Annals of Thoracic Medicine 6, no. 2 (2011): 70-76.
[29] Linhas, Rita, Raquel Marçôa, Inês Ladeira, Ricardo Lima, Regina Monteiro, Ivone Pascoal, and Aurora Carvalho. "Effects of Pulmonary Rehabilitation in Asthma Patients." European Respiratory Journal 50, no. suppl 61 (2017): PA757.
[30] Lan, Chou-Chin, Wen-Hua Chu, Mei-Chen Yang, Chih-Hsin Lee, Yao-Kuang Wu, and Chin-Pyng Wu. "Benefits of Pulmonary Rehabilitation in Patients with COPD and Normal Exercise Capacity." 58, no. 9 (2013): 1482-88.
[31] Laniado-Laborín, Rafael. "Smoking and Chronic Obstructive Pulmonary Disease (COPD). Parallel Epidemics of the 21 Century." International Journal of Environmental Research and Public Health 6, no. 1 (2009): 209-24.
[32] Kwak, Min Ji, Jongoh Kim, Viraj Bhise, Tong Han Chung, and Gabriela Sanchez Petitto. "National Trends in Smoking Cessation Medication Prescriptions for Smokers with Chronic Obstructive Pulmonary Disease in the United States, 2007-2012." Journal of Preventive Medicine and Public Health 51, no. 5 (2018): 257-62.
[33] Vestbo, Jørgen, Suzanne S. Hurd, Alvar G. Agustí, Paul W. Jones, Claus Vogelmeier, Antonio Anzueto, Peter J. Barnes, et al. "Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease." American Journal of Respiratory and Critical Care Medicine 187, no. 4 (2013): 347-65.
[34] Lee, Peter N., and John S. Fry. "Systematic Review of the Evidence Relating Fev1 Decline to Giving up Smoking." BMC Medicine 8 (2010): 84-84.
[35] Godtfredsen, Nina S., T. H. Lam, Trevor T. Hansel, M. E. Leon, N. Gray, C. Dresler, D. M. Burns, Eva Prescott, and Jorgen Vestbo. "COPD-Related Morbidity and Mortality After Smoking Cessation: Status of the Evidence." European Respiratory Journal 32, no. 4 (2008): 844-53.

asthma symptoms and lung function,[36] particularly when coupled with other therapies.[37] One study found that subjects with asthma who quit smoking saw improvements in lung function compared to those with asthma who continued smoking.[38] To optimize the management of asthma or COPD, clinicians should approach smoking cessation interventions by utilizing both behavioral (patient counseling and support) and pharmacological therapy for comprehensive treatment of asthma or COPD and improved outcomes.[39] Additionally, patients with asthma or COPD and who smoke are at a higher risk of pneumococcal disease and influenza. As such, clinicians should target these individuals for pneumococcal and influenza vaccinations to prevent asthma or COPD exacerbations.[40,41]

Overall, currently available research identifies areas of intervention primarily under the influence of clinicians, where evidence-based action can be taken to achieve better long-term health outcomes in the Medicare population.

2.2 Performance Gap

2.2.1 Rationale

Research has shown that both asthma and COPD are highly prevalent, costly conditions within the United States population, and their overall disease burden and financial impact continue to rise. [42,43] COPD is the third leading cause of death in the United States.[44] In 2014, 15.7 million Americans were diagnosed with COPD, yet this number could be an underestimation since many people with low lung function are not aware they have COPD.[45] The Centers for Disease Control and Prevention estimated that COPD-related costs grew by nearly $17 billion in the past decade in the United States, equating to an overall increase of 53%.[46,47] Specifically, Medicare paid 51% of these COPD-related costs.[48] One study found that the mean total health care costs

[36] Gratziou, Ch, A. Florou, E. Ischaki, K. Eleftheriou, A. Sachlas, S. Bersimis, and S. Zakynthinos. "Smoking Cessation Effectiveness in Smokers with COPD and Asthma Under Real Life Conditions." Respiratory Medicine 108, no. 4 (2014): 577-83.
[37] Perret, Jennifer L., Billie Bonevski, Christine F. McDonald, and Michael J. Abramson. "Smoking Cessation Strategies for Patients with Asthma: Improving Patient Outcomes." Journal of Asthma and Allergy 9 (2016): 117-28.
[38] Chaudhuri, Rekha, Eric Livingston, Alex D. McMahon, Jane Lafferty, Iona Fraser, Mark Spears, Charles P. McSharry, and Neil C. Thomson. "Effects of Smoking Cessation on Lung Function and Airway Inflammation in Smokers with Asthma." American Journal of Respiratory and Critical Care Medicine 174, no. 2 (2006): 127-33.
[39] Guarascio, Anthony J., Shauntá M. Ray, Christopher K. Finch, and Timothy H. Self. "The Clinical and Economic Burden of Chronic Obstructive Pulmonary Disease in the USA." ClinicoEconomics and Outcomes Research 5 (2013): 235-45.
[40] Torres, Antoni, Francesco Blasi, Nathalie Dartois, and Murat Akova. "Which Individuals Are at Increased Risk of Pneumococcal Disease and Why? Impact of COPD, Asthma, Smoking, Diabetes, and/or Chronic Heart Disease on Community-Acquired Pneumonia and Invasive Pneumococcal Disease." Thorax 70, no. 10 (2015): 984.
[41] Froes, Filipe, Nicolas Roche, and Francesco Blasi. "Pneumococcal Vaccination and Chronic Respiratory Diseases." International Journal of Chronic Obstructive Pulmonary Disease 12 (2017): 3457-68.
[42] Centers for Disease Control and Prevention. "Basics About COPD." https://www.cdc.gov/copd/basics-about.html.
[43] Asthma and Allergy Foundation of America. "Cost of Asthma on Society." https://www.aafa.org/cost-of-asthma-on-society/.
[44] American Lung Association. "How Serious Is COPD." https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/copd/learn-about-copd/how-serious-is-copd.html.
[45] Centers for Disease Control and Prevention. "Basics About COPD." https://www.cdc.gov/copd/basics-about.html.
[46] Ford, Earl S., Louise B. Murphy, Olga Khavjou, Wayne H. Giles, James B. Holt, and Janet B. Croft. "Total and State-Specific Medical and Absenteeism Costs of COPD among Adults Aged 18 Years in the United States for 2010 and Projections Through 2020." CHEST 147, no. 1 (2015): 31-45.
[47] Centers for Disease Control and Prevention. "COPD Costs." https://www.cdc.gov/copd/infographics/copd-costs.html.
[48] Ibid.

were $20,500 higher among Medicare patients with COPD compared to those without COPD.[49] Among the many factors that contribute to rising health care costs associated with COPD, increasing hospitalization and readmission rates are among the highest cost drivers.[50] COPD is the fourth leading cause of 30-day readmissions, where nearly one-fifth of patients hospitalized for an acute exacerbation of COPD were readmitted within 30 days of discharge. [51,52, 53]

More than 25 million Americans live with asthma,[54] and it has been estimated that 5% of all Medicare patients have an asthma diagnosis.[55] The total cost incurred for treatment of asthma was $81.9 billion in 2013.[56] Recent estimates attribute more than 10 million lost work days among employed adults and nearly 2 million emergency department (ED) visits over a single year to asthma.[57] Much like COPD, the burden of asthma falls heavily on adults aged 65 years and older, who have the highest mortality rate for the condition compared to any other age group.

Despite the differences in etiology, symptoms, and responses to therapy between asthma and COPD, these diseases overlap in disease presentation and pathophysiologic characteristics.[58,59] There is also a substantial 15 to 20% overlap in the reported prevalence of comorbid cases of asthma and COPD.[60] This overlapping relationship places an important role on clinicians to follow appropriate guidelines and utilize proper management strategies to classify and treat patients accurately.[61] Given the high impact in terms of patient population and Medicare spending, the Asthma/COPD measure represents an opportunity for improvement on overall cost performance.

The Asthma/COPD episode-based cost measure was recommended for development by an expert clinician committee—the Chronic Condition and Disease Management Clinical Subcommittee. Based on the initial recommendations from the Clinical Subcommittee, the subsequent measure-specific Clinician Expert Workgroup provided extensive, detailed input on this measure.

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[49] Menzin, Joseph, Luke Boulanger, Jeno Marton, Lisa Guadagno, Homa Dastani, Riad Dirani, Amy Phillips, and Hemal Shah. "The Economic Burden of Chronic Obstructive Pulmonary Disease (COPD) in a U.S. Medicare Population." Respiratory Medicine 102, no. 9 (2008): 1248-56.
[50] Parikh, Raj, Trushil G. Shah, and Rajive Tandon. "COPD Exacerbation Care Bundle Improves Standard of Care, Length of Stay, and Readmission Rates." International Journal of Chronic Obstructive Pulmonary Disease 11 (2016): 577-83.
[51] Ibid.
[52] Jencks, Stephen F., Mark V. Williams, and Eric A. Coleman. "Rehospitalizations Among Patients in the Medicare Fee-for-Service Program." The New England Journal of Medicine 360, no. 14 (2009): 1418-28.
[53] Ibid.
[54] Asthma and Allergy Foundation of America. "Asthma Facts and Figures." https://www.aafa.org/asthma-facts/.
[55] Centers for Medicare & Medicaid Services. "Health Disparities in the Medicare Population: Asthma." https://www.cms.gov/files/document/2016-05-cms-omh-data-snapshot-asthma-508pdf.
[56] Nurmagambetov, Tursynbek, Robin Kuwahara, and Paul Garbe. "The Economic Burden of Asthma in the United States, 2008–2013." Annals of the American Thoracic Society 15, no. 3 (2018): 348-56.
[57] American Lung Association. "Asthma in Adults Fact Sheet." https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/learn-about-asthma/asthma-adults-facts-sheet.html.
[58] Guarascio, Anthony J., Shauntá M. Ray, Christopher K. Finch, and Timothy H. Self. "The Clinical and Economic Burden of Chronic Obstructive Pulmonary Disease in the USA." ClinicoEconomics and Outcomes Research 5 (2013): 235-45.
[59] Cukic, Vesna, Vladimir Lovre, Dejan Dragisic, and Aida Ustamujic. "Asthma and Chronic Obstructive Pulmonary Disease (COPD) - Differences and Similarities." Materia Socio-Medica 24, no. 2 (2012): 100-05.
[60] Global Initiative for Chronic Obstructive Lung Disease. "Diagnosis of Diseases of Chronic Airflow Limitation: Asthma, COPD, and Asthma-Copd Overlap Syndrome (ACOS)." https://goldcopd.org/wp-content/uploads/2016/04/GOLD_ACOS_2015.pdf.
[61] Guarascio, Anthony J., Shauntá M. Ray, Christopher K. Finch, and Timothy H. Self. "The Clinical and Economic Burden of Chronic Obstructive Pulmonary Disease in the USA." ClinicoEconomics and Outcomes Research 5 (2013): 235-45.

2.2.2 Performance Scores

To demonstrate the performance gap captured in the measure, Table 1 below presents a distribution of performance scores for 20,642 clinician group practices and 44,430 practitioners attributed episodes in 2019. These counts represent attributed clinicians and clinician groups billing Part B Physician/Supplier claims under a MIPS eligible clinician specialty, and do not reflect other MIPS eligibility criteria (e.g., Advanced Alternative Payment Model (APM) participation). This table uses a testing volume threshold of 20 episodes.

Table 1. Distribution of Performance Scores

Metric	TIN	TIN-NPI
Mean score	$5,241	$5,259
Score Interquartile Range (IQR)	$1,856	$2,138
Score percentile		
10th	$3,388	$3,267
25th	$4,224	$4,074
50th	$5,144	$5,101
75th	$6,080	$6,212
90th	$7,113	$7,354

3.0 Scientific Acceptability

3.1 Data Sample Description

3.1.1 Type of Data Used for Testing

Medicare administrative claims, Long-Term Minimum Data Set (MDS), Medicare Enrollment Database (EDB), Common Medicare Environment (CME), and United States Census Bureau's American Community Survey (ACS).

3.1.2 Specific Dataset Used for Testing

The Asthma/COPD measure uses Medicare Part A, Part B, and Part D claims data maintained by CMS. Parts A, B, and D claims data are used to build episodes of care, calculate episode costs, and construct risk adjustors. To ensure that the measure accurately reflects Medicare costs, Part D branded drug costs were adjusted to account for drug rebates. More detailed information on the Part D payment standardization methodology and the Part D rebate adjustment methodology is available on the MACRA Feedback Page.[62]

Episode costs are payment standardized and risk adjusted to ensure accurate comparison of cost across clinicians. Payment standardization adjusts the allowed amount for a Medicare service to limit observed differences in costs to those that may result from health care delivery choices. Data from the EDB are used to determine beneficiary-level (or patient-level) exclusions and secondary risk adjustors, specifically Medicare Parts A, B, and C enrollment, primary payer, disability status, end-stage renal disease (ESRD), patient birth dates, and patient death dates. The risk adjustment model also accounts for expected differences in payment for services provided to patients in long-term care based on data from the MDS. Specifically, the MDS is used to create the long-term care indicator variable in risk adjustment.

For measure testing, data from the ACS and CME are used in analyses evaluating social risk factors in risk adjustment.

3.1.3 Dates of the Data Used in Testing

Asthma/COPD episodes ending from January 1, 2019 through December 31, 2019.

3.1.4 Levels of Analysis Tested

Individual clinician (identified by combination of TIN and NPI) and clinician group/practice (identified by TIN).

3.1.5 Entities Included in the Testing and Analysis

The overall population used for testing includes 63,650 clinician group practices and 317,679 practitioners, which includes any clinician groups/practitioners who had at least one Asthma/COPD episode in the measurement period. After applying exclusions and the case minimum, the final population for testing and analyses included 20,642 clinician group practices and 44,430 practitioners who were attributed 20 or more Asthma/COPD episodes across all 50 states and the District of Columbia during the measurement period. The most frequent settings in which an Asthma/COPD episode was triggered included:

- Ambulatory/office-based care;
- Skilled nursing facility (SNF); and
- Hospital outpatient department (HOD).

[62] CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.

3.1.6 Patient Cohort Included in the Testing and Analysis

2,526,604 Medicare patients, with a mean age of 72.83 (from 3,125,069 episodes) were included in the measure testing and analysis (where patient populations are not subject to any case minimum restrictions).

The patient population for the Asthma/COPD measure calculation consists of Medicare beneficiaries enrolled in Medicare Parts A and B (but not Part C) who receive medical care to manage asthma or COPD that triggers an Asthma/COPD episode. An Asthma/COPD episode is identified by a "trigger event," which is the occurrence of 2 Part B Physician/Supplier (Carrier) claims billed by the same clinician group practice within 180 days of one another. These claims include:

- A trigger claim, which is a "primary care" Evaluation & Management (E&M) code with a relevant asthma or COPD diagnosis; and
- A confirming claim, which is either another "primary care" E&M code with a relevant asthma or COPD diagnosis, or a chronic condition-related Current Procedural Terminology/Healthcare Common Procedure Coding System (CPT/HCPCS) code for related services with a relevant asthma or COPD diagnosis.

Patients and their episodes were excluded from the sample if they met a set of exclusion criteria (listed below) meant to ensure completeness of data and to focus the measure on a clinically homogeneous cohort of patients receiving medical care to manage asthma or COPD.

The exclusion criteria are:

- The patient does not have Medicare as their primary payer for the entire episode window, as well as the 120-day lookback period prior to the episode window.
- The patient was not continuously enrolled in Medicare Parts A and B, and not enrolled in Part C, for the entirety of the episode window and the 120-day lookback period.
- The patient was covered by the Railroad Retirement Board (RRB).
- The patient resided outside of the United States or its territories during the episode window.
- The patient was not found in the Medicare EDB.
- The patient has an episode window shorter than one year.
- The episode is an outlier case in the regression.
- The episode has no attributed clinician (only applied at the TIN-NPI level).
- The episode does not fall in any defined sub-groups (Asthma, COPD, Both Asthma and COPD).
- The patient had a prior long-term care hospital (LTCH) stay.
- The patient had cystic fibrosis.
- The patient had interstitial pulmonary fibrosis.
- The patient had prior lung cancer.
- The patient had prior lung surgery.
- The patient had prior lung transplant.
- The patient had stem cell transplant.
- The patient had sickle cell disease.

To determine whether the Asthma/COPD measure's exclusion criteria distort patient characteristics on episodes, we produced and analyzed distributions of patient characteristics (age, race, sex, dual eligibility status, income, unemployment, hierarchical condition categories [HCCs]) for (i) episodes with exclusion criteria, (ii) episodes without exclusion criteria, (iii) patients with exclusion criteria, and (iv) patients without exclusion criteria.

This analysis shows that the Asthma/COPD measure's exclusion criteria have only a minimal effect on the percentage of patients in any particular demographic category. The difference between patients being excluded and included in the measure is 3.25 or less percentage points across each of the characteristics in the analysis at TIN level testing, and 4.34 or less percentage points at TIN-NPI level testing. To illustrate, the percentage of patients aged 65 to 69 is 21.16% without applying the exclusion criteria, compared to 20.23% after applying the exclusion criteria at the TIN level. Furthermore, the difference in the percentage of patients across race categories with and without the exclusion criteria is 2.67 or less percentage points at both the TIN and TIN-NPI level testing. When it comes to gender, there is a difference of 0.49 or less percentage points between the included and excluded populations with regards to the share of male and female patients (for TIN and TIN-NPI level testing). These results indicate that there is minimal shift in patient characteristics as a result of using the exclusion criteria listed above at both TIN and TIN-NPI level testing.

3.1.7 Social Risk Factors Included in Analysis

The social risk factors analyzed were variables from the ACS, EDB, and CME. ACS variables are either at the Census Block Group or Zone Improvement Plan (ZIP) code level. Social risk variables analyzed include the following:

- Race (EDB)
  - Asian, Black, Hispanic, North American Native, White, and Other
- Sex (EDB)
  - Female, male
- Dual status (CME)
  - Full dual, partial dual, non-dual to indicate whether a patient is dually enrolled in Medicare and Medicaid
- Income (ACS)
  - Low Income: median income < 33rd percentile nationally
  - Medium Income: median income in the interval spanning the 33rd percentile to the 66th percentile nationally
  - High Income: median income > 66th percentile
- Education (ACS)
  - Education < High School: when % with < high school education is the highest for a given Census Block Group
  - Education = High School: when % with only high school is the highest
  - Education > High School: when % with > high school is the highest
- Employment (ACS)
  - Unemployment Rate > 10%
  - Unemployment Rate <= 10%
- Agency for Healthcare Research and Quality (AHRQ) Socioeconomic Status (SES) Index (ACS)
  - Continuous variable (composite score of multiple community-level metrics, such as property values, density of living spaces, and poverty level) that can theoretically range from 0 to 100[63]

[63] Refer to Section 3, page 42 of this AHRQ publication for the scoring algorithm used to calculate the AHRQ SES index variable.

3.2 Validity Testing

3.2.1 Level of Validity Testing

Our performance measure score validity testing included systematic assessment of both face validity and empirical validity testing.

3.2.2 Method of Validity Testing

Face Validity

The Asthma/COPD measure was developed through a structured, iterative process for gathering detailed input from recognized clinician experts on the measure. Experts in this clinical area evaluated specifications to ensure that each aspect of the measure (e.g., assigned services) was intentionally capturing only the costs of care within the reasonable influence of the attributed clinician for a defined patient population (i.e., the ability of the measure score to differentiate good from poor performance).

In developing this measure, Acumen incorporated input from:

(i) a Chronic Condition Disease Management Clinical Subcommittee;
(ii) an Asthma/COPD Clinician Expert Workgroup;
(iii) a Technical Expert Panel (TEP); and
(iv) the Person and Family Committee (PFC).

This process is detailed in the Episode-Based Cost Measures Development Process document posted on the MACRA Feedback Page.[64]

One of the key roles of the measure-specific Clinician Expert Workgroup was to develop service assignment rules for the cost measure. These service assignment rules are intended to ensure clinicians are evaluated on services and costs that are clinically related to the attributed clinician's role in managing asthma or COPD, thus limiting cost variation unrelated to clinician care this measure. Services performed in the following service categories are considered for assignment to the episode: outpatient (OP) facility and clinician services; ED; acute inpatient (IP) – medical; acute IP – surgical; inpatient rehabilitation facility (IRF); LTCH; durable medical equipment, prosthetics, orthotics, and supplies (DME); home health (HH); SNF; and Part D prescription drugs.

Empirical Validity Testing

We undertook 2 approaches to estimate the measure's validity. In the first approach, we evaluated the empirical validity of the Asthma/COPD measure by examining correlation with known indicators of resource or service utilization based on a literature review, specifically complications related to asthma or COPD. For this analysis, we compared the ratio of observed over expected spending at the provider level for Asthma/COPD episodes with and without complications. This analysis sought to confirm the expectation that the Asthma/COPD measure captures variation in service utilization as an indicator of clinician cost performance. We expect episodes with downstream acute readmissions or post-acute care (IRF, LTCH, HH, and SNF) would have higher observed to expected (O/E) cost ratios, since complications like these should yield higher cost, even after accounting for patient clinical characteristics via risk adjustment. Conversely, episodes without these downstream costs should have lower O/E cost ratios, demonstrating that the measure can differentiate good from poor cost performance.

In the second approach, we evaluated how different types of cost impact measure scores. To define types of cost, services or costs included in the Asthma/COPD measure were classified

[64] CMS, "2020 Episode-Based Cost Measures Field Testing Wave 3 Measure Development Process," MACRA Feedback Page, https://www.cms.gov/files/document/macra-cmft-ebcm-process-2020.pdf.

into clinically coherent groups of services, called “clinical themes.” The Asthma/COPD measure clinical themes are:

- **Asthma/COPD Chronic Care:** Outpatient care for asthma or COPD, including physician visits, laboratory work, and allergen testing among others.
- **Asthma/COPD Exacerbation:** Exacerbations of asthma or COPD requiring hospitalization, observation stays, or emergency room visits.
- **HH, Physical Therapy, Occupational Therapy, and Pulmonary Rehabilitation:** All HH and rehabilitation treatment related to asthma or COPD.
- **Other Post-Acute Care:** All post-acute care (SNF, IRF, LTCH), aside from HH, occurring after a hospitalization that can be influenced by the attributed clinician caring for a patient with asthma or COPD.
- **Non-Specific Symptoms:** Treatment for non-specific symptoms that could be complications of asthma or COPD. This includes dizziness, fatigue, and weakness.
- **Sepsis:** Inpatient treatment of sepsis from respiratory infections.
- **Pulmonary Imaging:** All pulmonary imaging, including pulmonary function tests. This includes chest x-ray, computed tomography (CT) scans, and magnetic resonance imaging (MRI).
- **Lung Surgery:** Lung surgery for the treatment of asthma or COPD, including resection of blebs and lung volume reduction surgery.
- **Other Respiratory Complications:** All inpatient and outpatient treatment for respiratory infections and symptoms. This includes symptoms such as cough and shortness of breath, as well as bronchitis, non-sepsis pneumonia, and others, but does not include cost for lung cancer or idiopathic pulmonary fibrosis (IPF).
- **Arrhythmias:** Inpatient or outpatient treatment of atrial arrhythmias, including episodes of syncope as these could be caused or exacerbated by asthma or COPD.
- **Nebulizers and Home Oxygen:** Any durable medical equipment required for nebulizer or oxygen use, as well as Part B Physician/Supplier nebulizer medications. This does not include any medications billed under Part D such as home inhalers.
- **Outpatient Medications for Chronic Care of Asthma/COPD:** Part D medications for the chronic care for asthma or COPD, including inhalers (i.e. tiotropium), oral medications (leukotriene inhibitors), and others. This includes albuterol and treatment for allergies.
- **Outpatient Medications for Asthma/COPD Exacerbations:** Part D medications for the treatment of asthma or COPD exacerbations, including steroids and antibiotics.
- **Outpatient Medications for Tobacco Cessation:** Part D medications for tobacco cessation.

As with the first analysis for validity, the aim of this analysis was to determine whether the measure is capturing variation in clinician or clinician group cost in the manner intended and expected. To measure this, we calculated the Pearson correlation between the cost of each complication-related clinical theme and the overall risk-adjusted cost for an episode, in order to confirm that the measure can capture variation in service utilization.

We expect that the clinical themes related to complications (i.e., respiratory complications) would have higher correlations with risk-adjusted episode cost, as complications are likely associated with high costs even after accounting for patient characteristics.

3.2.3 Statistical Results from Validity Testing

Table 2 below presents the results from the first analysis of validity. The mean O/E cost ratio for all episodes is 0.99. The mean O/E cost ratio for episodes with downstream acute readmission

is 3.08, compared with 0.64 for episodes without downstream acute readmission. Similarly, the mean O/E cost ratio for episodes with post-acute care is 2.88, compared with 0.81 for episodes without post-acute care. Additionally, there is greater variation in the O/E cost ratio among episodes with downstream acute readmission and post-acute care.

Table 2: Distribution of Observed to Expected Ratios

Episode Type	Observed / Expected Ratio										
	Mean	Std. Dev.	Percentile								
			1st	5th	10th	25th	50th	75th	90th	95th	99th
All Final Episodes	0.99	1.43	0.04	0.09	0.13	0.24	0.52	1.13	2.28	3.47	7.14
Episodes with Downstream Acute Readmission	3.08	2.29	0.59	0.86	1.07	1.58	2.47	3.83	5.78	7.45	11.77
Episodes without Downstream Acute Readmission	0.64	0.83	0.04	0.08	0.12	0.21	0.43	0.81	1.35	1.78	3.24
Episodes with Post-Acute Care (IRF, LTCH, HH, SNF)	2.88	2.46	0.25	0.46	0.65	1.20	2.24	3.74	5.86	7.64	12.06
Episodes without Post-Acute Care (IRF, LTCH, HH, SNF)	0.81	1.15	0.04	0.08	0.12	0.23	0.47	0.96	1.75	2.59	5.54

Table 3 below presents a subset of results from the clinical themes analysis that show the association between the measure's complication-related clinical themes and risk-adjusted cost. These results demonstrate that there is a moderate to high correlation between several complication-related themes and risk-adjusted cost. Themes with high correlations include Other Respiratory Complications (correlation: 0.41); Asthma/COPD Exacerbation (correlation: 0.35); Arrhythmias (correlation: 0.30); and HH, Physical Therapy, Occupational Therapy, and Pulmonary Rehabilitation (correlation: 0.28). Themes with moderate correlations include Sepsis (correlation: 0.17); Non-Specific Symptoms (correlation: 0.14); and Lung Surgery (correlation: 0.14).

Table 3: Clinical Themes

Clinical Theme	Pearson Correlation With Risk-Adjusted Cost
Asthma/COPD Exacerbation	0.35
HH, Physical Therapy, Occupational Therapy, and Pulmonary Rehabilitation	0.28
Other Post-Acute Care	0.12
Non-Specific Symptoms	0.14
Sepsis	0.17
Lung Surgery	0.14
Other Respiratory Complications	0.41
Arrhythmias	0.30

3.2.4 Interpretation

As expected, the average O/E cost ratios for episodes with complications (i.e., downstream acute readmissions and post-acute care) are higher than for episodes without downstream complications. These result demonstrates that the Asthma/COPD measure is able to accurately capture higher resource use, and suggests that episodes with complications (the frequency or severity of which could be reasonably expected to be influenced by the treatment of the attributed clinician or clinician group) will yield higher costs, even after risk adjustment.

Building on the first validity analysis, the results from the clinical themes analysis demonstrate a moderate to high correlation between several of the complication-related themes and risk-adjusted cost, including Asthma/COPD Exacerbation; Other Respiratory Complications; Arrhythmias; and HH, Physical Therapy, Occupational Therapy, and Pulmonary Rehabilitation. This indicates that the measure is able to accurately capture higher resource use. This relationship exists for both high-cost and low-cost themes. For example, the correlation with risk-adjusted cost is moderate for high-cost themes such as Lung Surgery and Sepsis themes (average cost: $19,113 and $12,660, respectively), but also for lower cost themes such as Non-Specific symptoms (average cost: $402). This indicates that the correlation does not come from a mechanical increase in episode costs from high-cost themes.

3.3 Exclusions Analysis

3.3.1 Method of Testing Exclusions

Exclusions are used in the Asthma/COPD measure to ensure a comparable patient population within the scope of the measure's focus on the chronic management of asthma or COPD and that episodes provide meaningful information to attributed clinicians. Exclusions are also used as part of data processing so that sufficient data are available to accurately determine episode spending and calculate risk adjustment for each episode. For the exclusions analysis discussed in this section, we focused on exclusions added to ensure a homogenous patient population. These exclusions, along with their rationales, are listed below:

- Episodes where the patient's episode window length is less than one year.
    - These episodes were excluded because the methodology for the chronic measures requires at least one year of claims data to measure clinician cost performance during an open attribution window for a performance period. Additionally, this exclusion may capture episodes during which a patient died, given that there may be insufficient data for these episodes. However, episodes with a death event are still included as long as the episode window is at least one year long.
- Episodes where there is not an attributed clinician.
    - These episodes were excluded because the episode does not have any TIN-NPIs that billed at least 30% of "primary care" E&M codes with a relevant asthma or COPD diagnosis and/or chronic condition-related CPT/HCPCS codes for related services with a relevant asthma or COPD diagnosis on Part B Physician/Supplier (Carrier) claim lines during the episode within the attributed TIN. This exclusion only applies to episodes at the TIN-NPI level, while attributed TIN would continue to be attributed these episodes.
- Episodes where the patient is not in a defined sub-group.
    - These episodes were excluded because the patient's asthma or COPD diagnosis could not be determined based on their available claims data. Episodes are sub-grouped into Asthma, COPD, and Both Asthma and COPD to ensure clinical

comparability so that the measure fairly compares clinicians with a similar patient case-mix.

- The following episode populations were excluded because they each make up a small group of the final episode population, are expected to be more clinically complex, and the variance in costs for these high-risk patient cohorts are expected to be higher and would likely not be adequately accounted for by risk adjustment:
    - Episodes where the patient had interstitial pulmonary fibrosis;
    - Episodes where the patient had prior lung cancer;
    - Episodes where the patient had a prior LTCH stay;
    - Episodes where the patient had a stem cell transplant;
    - Episodes where the patient had a prior lung transplant;
    - Episodes where the patient had sickle cell disease;
    - Episodes where the patient had cystic fibrosis; and
    - Episodes where the patient had prior lung surgery.
- Episodes classified as outlier cases.
    - To account for limitations of risk adjustment, episodes predicted to have expected costs that are substantially different from observed costs are excluded as outliers. Specifically, episodes with residuals from the risk adjustment model below the 1st percentile and above the 99th percentile are considered outliers and removed from measure calculation.

Given the rationales for these exclusions, we would expect these excluded episodes to have a different risk profile than the included episodes, such as a higher mean cost, or a different distribution of costs (e.g., a long tail of high-cost episodes). For the exclusions, we examined the number of episodes and patients affected, as well as the distributions of observed cost and ratio of observed over expected spending (calculated by applying existing risk factor coefficients to the excluded episodes) for excluded episodes. We then compared the cost characteristics of the excluded episodes to those of final episodes included in measure calculation to assess the distinctness between the 2 patient cohorts. A full list of the exclusions used for the Asthma/COPD measure is provided in the draft Measure Codes List available on the MACRA Feedback Page.[65]

3.3.2 Statistical Results from Testing Exclusions

Table 4 below presents observed cost statistics and O/E cost ratios for the Asthma/COPD measure exclusions. Cost statistics are also provided for the set of final episodes included in the Asthma/COPD measure for comparison, with a testing volume threshold of 20 episodes at the TIN and TIN-NPI levels. For the standard exclusions in the table below (i.e., episode length less than one year, no attributed clinician, no defined sub-group), these patient cohorts are excluded from the measure in order to assess episodes in the intended setting and by the measure's intended attribution approach.

[65] CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.

Table 4: Cost Statistics for Measure Exclusions*

Exclusion	Episodes		Observed Cost			O/E Cost Ratio		
			Mean	Percentile		Mean	Percentile	
	#	%		10th	90th		10th	90th
All Episodes Meeting Triggering Logic	3,518,313	100.00%	$7,854	$463	$18,467	1.18	0.12	2.57
Episode Length Less Than One Year	170,263	4.84%	$40,617	$1,662	$104,908	4.43	0.21	10.72
No Attributed Clinician (TIN-NPI Level)	13,521	0.38%	$12,982	$1,183	$33,986	1.79	0.25	4.10
No Defined Sub-group	1,419	0.04%	$1,431	$138	$3,272	1.00	1.00	1.00
Interstitial Pulmonary Fibrosis	134,560	3.82%	$15,285	$921	$36,219	1.47	0.15	3.34
Prior Lung Cancer	111,281	3.16%	$15,446	$1,148	$35,184	1.62	0.18	3.55
Prior LTCH Stay	12,383	0.35%	$42,981	$1,572	$109,906	2.11	0.10	5.24
Stem Cell Transplant	3,051	0.09%	$15,758	$788	$34,384	1.94	0.16	4.15
Prior Lung Transplant	1,990	0.06%	$14,655	$1,036	$29,396	1.42	0.14	2.80
Sickle Cell Disease	1,968	0.06%	$11,806	$672	$25,557	1.34	0.13	2.96
Cystic Fibrosis	1,305	0.04%	$19,635	$1,074	$47,809	2.87	0.21	6.91
Prior Lung Surgery	1,281	0.04%	$14,220	$1,113	$27,259	1.22	0.14	2.51
Outlier Cases	62,496	1.78%	$28,875	$984	$65,349	4.89	0.07	13.50
Final Episodes (TIN)	2,812,186	79.93%	$5,378	$438	$13,895	0.92	0.12	2.13
Final Episodes (TIN-NPI)	2,096,664	59.59%	$5,323	$452	$13,682	0.92	0.12	2.11

*This table does not include all measure exclusions.

3.3.3 Interpretation

The statistical results indicate that the majority of excluded episodes differ substantially in both mean observed cost and mean O/E cost ratio and have larger variation compared to the final set of episodes. These results support the exclusion of these episodes to ensure a comparable patient cohort that will yield meaningful information to attributed clinicians. Further discussion of the results for exclusions applied based on the clinical validity of the study population are provided below.

Episodes where the patient had interstitial pulmonary fibrosis: These episodes present more cost and have a higher O/E cost ratio than the final set of episodes. The mean observed cost ($15,285) is nearly 3 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). This is also observed at the 90th percentile. The mean O/E cost ratio of these episodes is 1.47 compared to the final episodes at 0.92 for both TIN and TIN-NPI level testing. Furthermore, these episodes have wider variation in the O/E cost ratio, ranging from 0.15 at the 10th percentile and 3.34 at the 90th percentile, compared to the final episodes.

Episodes where the patient had prior lung cancer: These episodes present more cost and have a higher O/E cost ratio than the final set of episodes. These episodes have a mean observed cost ($15,446) that is nearly 3 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). This is also observed at the 90th percentile. The mean O/E cost ratio of these episodes is 1.62 compared to the final episodes at 0.92 for both TIN and TIN-NPI levels. Finally, these episodes have wider variation in the O/E cost ratio, ranging from 0.18 at the 10th percentile and 3.55 at the 90th percentile, as compared to the final episode population.

Episodes where the patient had a prior LTCH stay: These episodes present more cost and variation in the O/E cost ratio than the final set of episodes. The mean observed cost of these

episodes ($42,981) is 8 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing), and this difference becomes more distinct at the 90th percentile with an observed cost of $109,906 compared to nearly $14,000 for the final episodes at the TIN and TIN-NPI level testing. In addition, the mean O/E cost ratio is 2.11 (compared to the final episodes at 0.92 for both TIN and TIN-NPI level testing), and the O/E cost ratio shows substantial variation (compared to the variation in the final episodes), ranging from 0.10 at the 10th percentile to 5.24 at the 90th percentile.

Episodes where the patient had a stem cell transplant: These episodes have a mean observed cost ($15,758) that is nearly 3 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). The mean O/E cost ratio of these episodes is 1.94 compared to 0.92 for both TIN and TIN-NPI levels. There is also substantial variation in the O/E cost ratio, ranging from 0.16 at the 10th percentile and 4.15 at the 90th percentile.

Episodes where the patient had a prior lung transplant: These episodes present more cost, with a mean observed cost ($14,655) that is a little over 2.5 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). The mean O/E cost ratio of these episodes is 1.42 compared to 0.92 for both TIN and TIN-NPI levels, and there is substantial variation in the O/E cost ratio, ranging from 0.14 at the 10th percentile and 2.80 at the 90th percentile.

Episodes where the patient had sickle cell disease: These episodes have a mean observed cost ($11,806) that is double that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). This is also observed at the 90th percentile. The mean O/E cost ratio of these episodes is 1.34 compared to 0.92 for both TIN and TIN-NPI levels. There is also substantial variation in the O/E cost ratio, ranging from 0.13 at the 10th percentile and 2.96 at the 90th percentile.

Episodes where the patient had cystic fibrosis: The mean O/E cost ratio for these episodes (2.87) is substantially larger than for final episodes (0.92 for both TIN and TIN-NPI level). The difference in patient cohort becomes more pronounced at the 90th percentile, where the O/E cost ratio is 6.91, compared to 2.13 and 2.11 for final episodes at the TIN and TIN-NPI level testing, respectively.

Episodes where the patient had prior lung surgery: These episodes present more cost, with a mean observed cost ($14,220) that is 2.5 times that of the final set of episodes ($5,378 at the TIN level testing and $5,323 at the TIN-NPI level testing). There is also a substantial variation in the O/E cost ratio, ranging from 0.14 at the 10th percentile and 2.51 at the 90th percentile.

Episodes classified as outlier cases: The mean observed cost of these episodes is over 5 times greater than for the final set of episodes at both the TIN and TIN-NPI level testing. The O/E cost ratio ranges from 0.07 at the 10th percentile to 13.50 at the 90th percentile, indicating that the risk adjustment model is currently unable to account for the patient characteristics associated with these high- and low- cost outlier episodes. Excluding outliers based on risk-adjusted cost eliminates the episodes that deviate most from expected spending levels based on patient characteristics.

3.4 Risk Adjustment or Stratification

3.4.1 Method of Controlling for Differences

Differences in case mix are controlled for using a statistical risk model with 126 risk factors and stratification by 6 risk categories. These 6 risk categories account for the 3 sub-groups stratified by Part D enrollment status (either enrolled or not enrolled in Medicare Part D during the episode window).

The risk adjustment model for the Asthma/COPD measure broadly follows the CMS-HCC risk adjustment methodology, which is derived from Medicare Parts A and B claims and is used in the Medicare Advantage (MA) program. Patient age is included as 1 of 12 age categorical variables derived from the MA risk adjustment model's age/sex variables. Severity of illness is measured using HCCs, indicators of enrollment and long-term care status, and disease interactions. The risk adjustment model also includes variables for factors identified by the expert clinician workgroup as affecting resource use.

The model includes 79 HCC indicators derived from the patients' Parts A and B claims during the period 120 days prior to the episode trigger claim and are specified in the CMS-HCC Version 22 (V22) 2016 model. Episodes for patients without a full 120-day lookback period are excluded from the measure. This 120-day period is used to measure patient health status and ensures that each patient's claims record contains sufficient fee-for-service data both for measuring spending levels and for risk adjustment purposes.

In addition, the risk adjustment model includes status indicator variables for whether the patient qualifies for Medicare through Disability or ESRD. The model also includes an indicator of whether the patient recently required long-term care, defined as 90 days in a long-term care facility without being discharged to community for 14 days. Patients who need to reside in long-term care facilities typically require more intensive care than patients who live in the community. These enrollment and long-term care status variables are non-diagnostic indicators of severity of illness.

The model also accounts for disease interactions between HCCs and/or enrollment status variables included in the MA model. These interactions are included because certain combinations of comorbidities increase costs more than is predicted by the HCC indicators alone.

Furthermore, the risk adjustment model includes measure-specific factors intended to further isolate costs that attributed clinicians can reasonably influence, informed by expert clinician input and empirical analyses. The following variables were added to avoid potential unintended consequences:

- Whether the patient:
    - Had prior long-term systemic steroid use;
    - Had obstructive sleep apnea;
    - Had dementia;
    - Had a recent all-cause admission;
    - Had anxiety;
    - Had respiratory failure;
    - Had prior intubation for respiratory issue;
    - Was in a wheelchair;
    - Was obese;
    - Used home oxygen;
    - Used a home hospital bed;
    - Received prior pulmonary rehabilitation; and

    - Smoked.
- Whether the patient had a recent asthma or COPD admission, specifically:
    - Had 1 recent asthma or COPD admission;
    - Had 2 to 3 recent asthma or COPD admissions; and
    - Had 4 and more recent asthma or COPD admissions.
- Whether the patient has a recent asthma or COPD emergency room (ER)/observation visit, specifically:
    - Had 1 recent asthma or COPD ER/observation visit;
    - Had 2 to 3 recent asthma or COPD ER/observation visits; and
    - Had 4 and more recent asthma or COPD ER/observation visits.

The risk adjustment approach for this measure uses an ordinary least squares linear regression model for each sub-group and Medicare Part D enrollment status combination to ensure fair comparison. The episode group's annualized observed costs are winsorized at the 1st and 99th percentiles prior to the regression for each model to handle extreme observations. Then, the predicted, or expected, cost is winsorized at 0.5th percentile to make sure episodes with unusually small predicted cost, which would lead to abnormally large O/E cost ratios, do not dominate certain clinicians' final score. The winsorized expected costs are renormalized to ensure the average expected episode cost is the same before and after winsorizing. Then, as presented in the exclusions analysis above, extremely low- or high-cost outlier episodes with residuals below the 1st percentile or above the 99th percentile are excluded to reduce the effect of episodes that deviate the most from their expected values in absolute terms. The expected cost after excluding these outliers is again renormalized to ensure that average expected costs are the same after outlier removal.

Finally, the risk adjustment model outlined above is stratified for each of the 3 Asthma/COPD measure sub-groups below:

- Asthma
- COPD
- Both Asthma and COPD

Once patients have been sub-grouped, sub-groups are stratified by a patient's Medicare Part D enrollment status (either enrolled or not enrolled in Part D). This means that for each measure-specific sub-group, a separate risk adjustment model is run for patients with and without Part D enrollment. This is done to account for differences in patient populations and their associated cost with and without Part D enrollment, and stratifying by Part D enrollment improves the model fit compared to not stratifying by enrollment status.

Full details of the risk adjustment model are in the draft Measure Codes List File.[66]

3.4.2 Conceptual, Clinical, and Statistical Methods

We selected the CMS-HCC model based on previous studies evaluating its appropriateness for use in risk adjusting Medicare claims data. This model was developed specifically for use in the Medicare population, meaning that it accounts for conditions found in the Medicare population and is calibrated on Medicare fee-for-service beneficiaries. In addition, the CMS-HCC model is routinely updated for changes in coding practices (e.g., the transition from the 9th revision of the International Statistical Classification of Diseases and Related Health Problems, or ICD-9, to ICD-10 codes) and is exhaustive on these code sets. Because the CMS-HCC model has

[66] CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.

already been extensively tested, we focus our testing on how the CMS-HCC model was adapted to the Asthma/COPD measure methodology.

The workgroup provided input on measure-specific risk adjustors after reviewing empirical analyses on subpopulations of interest to assess whether and if so, how, particular factors should be accounted for in the model. These could include patient characteristics, factors outside of the reasonable influence of the clinician, or any other factors that would help prevent unintended consequences. These additional risk adjustors are listed in the section above.

As previously noted, the risk adjustment model is run on episodes stratified into sub-groups, which may qualify as "ordering" of risk factors. Sub-groups were also determined based on the workgroup's input, with the goal of ensuring clinical comparability among episodes so that the cost measure fairly compares clinicians with similar patient case-mix. The sub-groups are listed in the above section. Patients with the majority of their diagnosis (equal to or greater than 85%) belonging to asthma or COPD were separated into different sub-groups (Asthma sub-group or COPD sub-group), since these are considered different patient cohorts with different cost patterns and risk profiles, and patients with both asthma and COPD as their prevalent diagnoses are defined as the third sub-group (Both Asthma and COPD sub-group) considering the complexity of both existing conditions.

3.4.3 Conceptual Model of Impact of Social Risks

Our conceptual model of the impact of social risk factors is informed by both published external research and our own data analysis.[67,68,69]

3.4.4 Statistical Results

The literature has extensively tested the use of the HCC model as applied to Medicare claims data. Although the variables in the HCC model were chosen to predict annual cost, CMS has also used this risk adjustment model in a number of other settings (e.g., Accountable Care Organizations (ACOs), previous physician Quality and Resource Use Reports (QRUR) programs, and other measures such as the National Quality Forum (NQF) #3512: Knee Arthroplasty, NQF #3509: Routine Cataract Removal with Intraocular Lens (IOL) Implantation, NQF #3510: Screening/Surveillance Colonoscopy, and NQF #2158: MSPB Hospital cost measures). Recalling that the risk model relies on the existing CMS-HCC model, testing results for factors included in the CMS-HCC V22 2016 model can be found in the Evaluation of the CMS-HCC Risk-Adjustment Model report[70] and the Report to Congress: Risk Adjustment in Medicare Advantage.[71] For measure-specific factors not included in the CMS-HCC model, we sought expert clinician input through the workgroup, which provided recommendations on additional risk adjustors and sub-groups.

3.4.5 Analyses and Interpretation in Selection of Social Risk Factors

Acumen analyzed gender, dual status, income, education, and unemployment as social risk factors (more information on these variables can be found in Section 3.1.7). Patient gender and

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[67] Assistant Secretary of Health and Human Services for Planning and Evaluation. Report to Congress: Social Risk Factors and Performance Under Medicare's Value-Based Purchasing Programs. Washington, D.C. December 2016.
[68] Chen LM, Epstein AM, Orav EJ, Filice CE, Samson LW, Joynt Maddox KE. Association of Practice-Level Social and Medical Risk With Performance in the Medicare Physician Value-Based Payment Modifier Program. JAMA. 2017;318(5):453-461
[69] Medicare Payment Advisory Commission. Beneficiaries Dually Eligible for Medicare and Medicaid. 2018; https://www.macpac.gov/publication/data-book-beneficiaries-dually-eligible-for-medicare-and-medicaid-3/.
[70] Pope, Gregory C., John Kautter, et al., "Evaluation of the CMS-HCC Risk-Adjustment Model: Final Report." RTI International: March 2011.
[71] CMS, "Report to Congress: Risk Adjustment in Medicare Advantage," https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Downloads/RTC-Dec2018.pdf.

dual status were obtained from the EDB and CME. Information on income, education, and unemployment was obtained from ACS data and linked to episodes by census block group where possible to provide a more granular level of analysis than ZIP code. Patients without geographic information necessary to obtain ACS data were excluded, representing less than 2% of episodes.

The percentage of female patients range from 48.99 to 72.19% across the 3 sub-groups, stratified by Part D enrollment, in this measure. The Asthma sub-group has a higher percentage of female patients, which is supported by current literature suggesting there are gender effects and differences in the incidence and severity of asthma, where women have a higher prevalence and more severe cases of asthma.[72] The COPD sub-group has a lower percentage of female patients, which could be explained by potential under-diagnosis of COPD among women.[73] The majority of the patients (67.40 to 99.41%) have non-dual status. Income level is categorized into high, medium, and low from the continuous average income variable in ACS; therefore, each category has 33% of observations. While 1.34 to 3.23% of patients are classified below a high school education level, the overwhelming majority of episodes are classified at a high school level or greater. Finally, 16.54 to 20.18% of patients have high unemployment designation (>10%).

Acumen examined the impact of including social risk factors into our risk adjustment model by running goodness of fit tests when different risk factors are added and compared to the base risk adjustment model, where the base risk adjustment model refers to the full standard set of risk adjustment variables from the CMS-HCC V22 2016 model, disability status, ESRD status, interaction variables, recent long-term care use, and measure-specific clinical risk adjustors. Acumen ran a step-wise regression to include the following additional social risk factors on top of the adapted CMS-HCC model:

- Gender
- Dual status
- Gender + dual status
- Gender + dual status + race
- Gender + dual status + income + education + unemployment
- Gender + dual status + AHRQ SES index score
- Gender + dual status + race + income + education + unemployment
- Gender + dual status + race + AHRQ SES index score

The step-wise regressions help evaluate individual as well as joint significance of the social risk factors. We examined the impact of including social risk factors into our risk adjustment model with T-test of individual significance and F-test of joint significance.

First, we analyzed the model coefficients and p-values for each of the base and social risk factor models to understand whether any of the social risk factor covariates are predictive of episode cost. The T-test and F-test revealed many significant p-values, indicating that social risk factors are likely predictive factors for determining resource use among patients for the relevant characteristic. However, the analysis also shows that the significance of the effects of social risk factors is not consistent. For example, Asian patients have higher expected costs for the COPD sub-group without Part D enrollment compared to the other sub-groups stratified by Part D enrollment. Additionally, there are differences in significance levels across social risk factor variables between the sub-groups stratified by Part D enrollment. Using the same example, the

[72] Zein, Joe G., Serpil C. Erzurum. “Asthma is Different in Women.” Current Allergy and Asthma Reports 15, no. 6 (2015): 28.
[73] Chapman, Kenneth R. "Chronic Obstructive Pulmonary Disease: Are Women More Susceptible Than Men?" Clinics in Chest Medicine 25, no. 2 (2004): 331-341.

regression coefficients for Asian patients are statistically significant at the 0.05 level for all sub-groups stratified by Part D enrollment, except for the Asthma sub-group without Part D enrollment (significant at 0.10 level) and the Both Asthma and COPD sub-group without Part D enrollment.

Second, we analyzed the impact of adding social risk variables on overall model performance by looking at the differences in the ratio of observed to expected episode cost (O/E) with and without social factors in the risk adjustment model. When including social risk factors in our risk adjustment regression, there were some differences in the O/E cost ratios at both reporting levels. Overall, the measure scores for 89.51% of TINs and 92.13% of TIN-NPIs did not change or changed by 5 percentiles or less.

Finally, we analyzed the correlation between measure scores calculated with and without the social risk factors. The measure scores calculated with and without these social factors were highly correlated at both the TIN and TIN-NPI levels, with a Spearman correlation coefficient of 0.99 at both levels.

Overall, our analyses about the impact of social risk factor effects under the current risk adjustment model yielded inconsistent results. For the first and third analyses, we found that the significance and direction associated with including social risk factors is not consistent, and that the measure scores calculated with and without social risk factors were highly correlated at both reporting levels. However, for the second analysis, 10.49% of TINs and 7.87% of TIN-NPIs observed some shift in performance with the inclusion of social risk factors in the model. These results indicate that the inclusion of social risk factors in the current risk adjustment model has some effect on the measure scores. Therefore, these results warrant further investigation into the social risk factors that drive these shifts under the current model, which we plan to investigate after the field testing period.

3.4.6 Method for Statistical Model or Stratification Development

To analyze the validity of the current risk adjustment model, we examined 2 analyses: (1) R-squared and adjusted R-squared for the regression models, and (2) predictive ratios and O/E cost ratios to examine the fit of the models at different levels of patient complexity.

1) R-squared and adjusted R-squared were calculated for the measure. These results should be evaluated in the context of the measure's service assignment rules which are intended to ensure only clinically associated costs are grouped to episodes. This is an important distinction from all-cost measures as service assignment leaves less variation for the risk adjustment model to explain. In this context, a low R-squared may indicate the effectiveness of the service assignment rules. These results are provided in Section 3.4.7.
2) Predictive ratios and O/E cost ratios were calculated for each "risk decile" for the episode group. A "risk decile" is based on the risk scores, which indicate how costly episodes are expected to be, as predicted through risk adjustment. After arranging episodes into deciles based on their risk score, we calculated the predictive ratios and average O/E cost ratios for each decile. The predictive ratio aims to examine the fit of the model at different levels of patient complexity to examine the model's ability to predict both very low and high cost episodes, and is calculated using the formula of average (expected cost)/average (observed cost) for all episodes in each decile. Similarly, the O/E cost ratio demonstrates the model's prediction accuracy, and is calculated using the formula of average (observed cost/expected cost) for all episodes in each decile. These are discussed in Sections 3.4.8 and 3.4.9.

3.4.7 Statistical Risk Model Discrimination Statistics

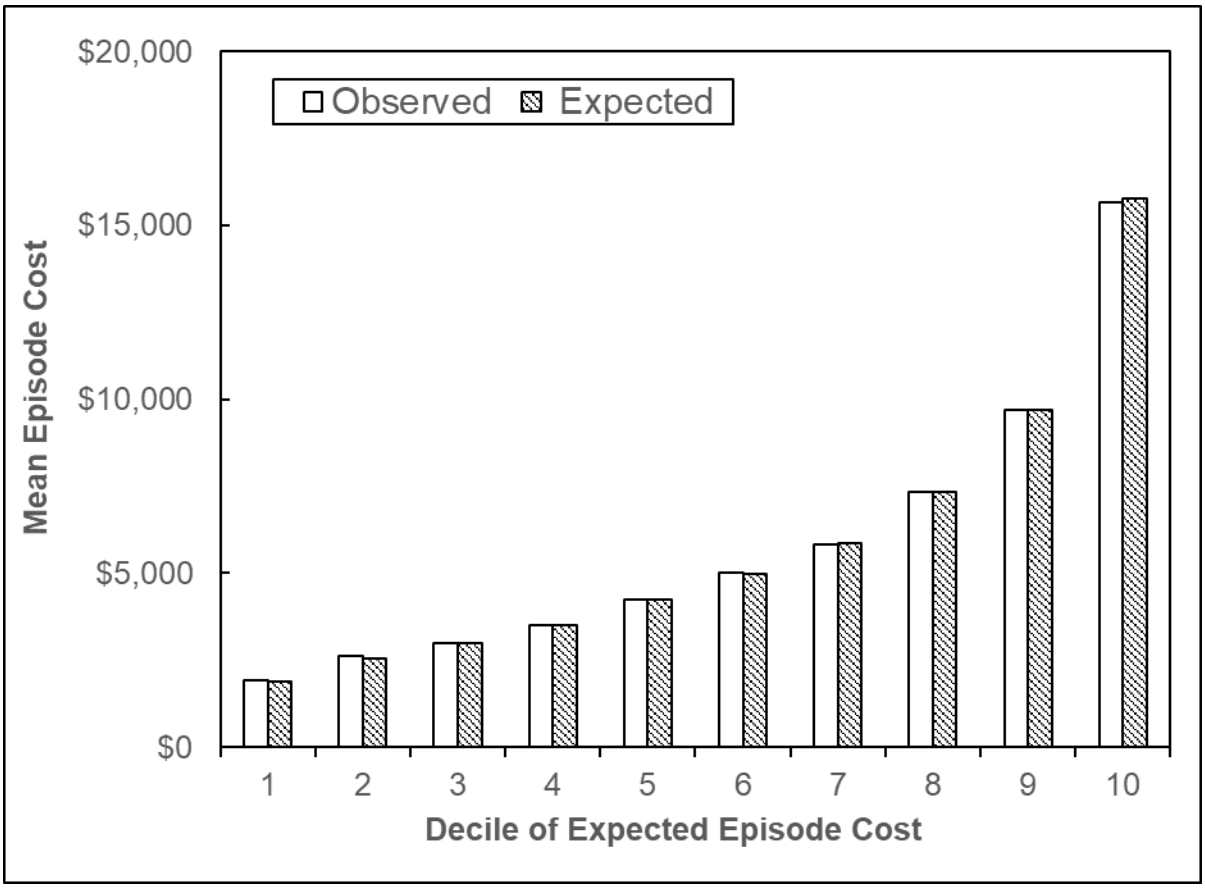
The overall R-squared for the Asthma/COPD cost measure, calculated by dividing explained sum of squares by total sum of squares is 0.19. The adjusted R-squared is 0.19. More

information on discrimination testing for the CMS-HCC model can be found at Pope et al. 2011.[74]

3.4.8 Statistical Risk Model Calibration Statistics

We interpret calibration as how accurately the risk model's predictions match the actual episode cost. We calculate the average O/E cost ratio for each risk decile to demonstrate the model's prediction accuracy. Across all episodes, the average O/E cost ratio is 1.07, with average ratios ranging from 1.04 (10th risk decile) to 1.14 (1st decile). In risk deciles below the 5th risk decile, average O/E cost ratios range from 1.08 to 1.14, while the 5th to 10th risk deciles have average ratios ranging from 1.04 to 1.06. Full results are presented in Figure 1 below.

Figure 1. Risk Adjustment Model Diagnostics: Comparison of Observed and Expected Cost by Expected Cost Risk Deciles



3.4.9 Statistical Risk Model Calibration – Risk Decile

Analysis of predictive ratios by risk decile for the measure shows that the model has consistent predictive ratios across risk score deciles, with each decile having a predictive ratio between 0.98 and 1.01. The average predictive ratio is 1.00.

[74] Pope, Gregory C., John Kautter, et al., "Evaluation of the CMS-HCC Risk-Adjustment Model: Final Report." RTI International: March 2011.

3.4.10 Interpretation

The R-squared values for the model, which measure the percentage of variation in results predicted by the model, are higher than the values presented in similar analyses of risk adjustment models.[75] As noted in Section 3.4.6, these results should be interpreted alongside service assignment rules, which remove clinically unrelated services, so the resulting variation is reflective of variation related to factors within a clinician's reasonable influence.

As demonstrated in Section 3.4.8, the average O/E cost ratios are greater than one across all risk deciles, but higher in the lower risk deciles. This indicates that the model under-predicts observed episode cost in all risk deciles, but slightly less in the highest risk decile. Conversely, as demonstrated in 3.4.9, the predictive ratios for all risk deciles are close to one, indicating that the expected cost is accurately predicting observed cost. While previous testing has been conducted to inform potential improvements to the measure's risk adjustment model, we plan to conduct further analyses after the field testing period to continue improving the model's predictive abilities.

3.5 Identification of Meaningful Differences in Performance

3.5.1 Method

Our method of determining clinically meaningful differences in episode-based cost measure performance consists of stratifying clinician measure O/E cost ratios by meaningful characteristics and investigating the clinician O/E cost ratio distribution by percentile. The cost measure score numerator is the sum of the O/E cost ratio for all episodes attributed to a clinician. This sum is then multiplied by the national average observed episode cost to generate a dollar figure. The denominator is the total number of episodes from the attributed to a clinician. Using O/E cost ratios allows for direct comparisons of performance at the sub-group level since a dollar figure cannot be calculated for those episodes using the national average observed episode cost. Stratification is performed for each of the following characteristics: urban/rural, census division, census region, risk score, and the number of episodes attributed to the clinician or clinician group. We analyze the distribution of measure O/E cost ratios for clinicians defined by these characteristics.

The purpose of this analysis is to ensure that there is a sufficiently large difference in measure O/E cost ratios among clinicians to determine a meaningful difference in performance. In addition, this analysis looks to confirm that the measure behaves as expected with respect to meaningful clinician characteristics.

3.5.2 Statistical Results

Key findings show that, generally, there is a large performance difference among clinicians in the Asthma/COPD measure:

(i) The 99th percentile of the measure O/E cost ratio is over 4 times the measure O/E cost ratio at the 1st percentile for both the TIN level and TIN-NPI levels; and
(ii) The Asthma/COPD measure O/E cost ratio at the 90th percentile is approximately 109.94% and 125.08% greater than the O/E cost ratio at the 10th percentile at both the TIN and TIN-NPI levels, respectively.

These results indicate there is a large potential for Medicare cost savings.

[75] Pope, Gregory C., John Kautter, Melvin J. Ingber, Sara Freeman, Rishi Sekar, and Cordon Newhart. "Evaluation of the CMS-HCC Risk-Adjustment Model: Final Report." RTI International: March 2011.

In terms of regional difference in clinician O/E cost ratios, clinicians in urban areas seem to perform comparable to those in rural areas. Similarly, the mean O/E cost ratios for clinicians across the 4 census regions (excluding 'Unknown') are within a 0.05 or less range (i.e., 0.95-0.99 at the TIN level and 0.95-1.00 at the TIN-NPI level), indicating minimal to no variation. The mean O/E cost ratios for clinicians across 9 census divisions (excluding 'Unknown') are within a 0.11 range at the TIN level (0.94-1.05) and within a 0.10 range at the TIN-NPI level (0.94-1.04), indicating some/moderate variation.

In terms of other clinician characteristics, analysis of clinicians by number of episodes indicates that clinicians with more episodes perform similarly to those with fewer episodes. We also analyzed clinicians by risk score decile, as variation by risk score decile could indicate that the risk adjustment model is over- or under-correcting for clinicians with systematically riskier patients. Measure O/E cost ratios show some/moderate variation by risk score decile, with a range in mean TIN O/E cost ratio of 0.90 to 1.09 and a range in mean TIN-NPI O/E cost ratio of 0.88 to 1.08.

Tables 5-A and 5-B below present the distribution of cost measure O/E cost ratios by a range of clinician/clinician group characteristics, allowing a comparison of O/E cost ratio distributions for these breakdowns. The measure O/E cost ratios are presented at the TIN level (Table 5-A) and the TIN-NPI level (Table 5-B).

Table 5-A: Asthma/COPD TIN Level Cost Measure O/E Cost Ratios

Characteristic	# of TINs	Mean O/E Ratio	O/E Percentile						
			1st	10th	25th	50th	75th	90th	99th
All TINs	20,642	0.97	0.41	0.63	0.78	0.95	1.13	1.32	1.82
Sub-group									
Asthma	19,209	0.94	0.11	0.37	0.56	0.81	1.12	1.56	3.70
Both Asthma and COPD	20,338	0.98	0.18	0.43	0.63	0.89	1.18	1.58	3.10
COPD	20,463	0.98	0.28	0.55	0.74	0.95	1.16	1.40	2.24
Urban/Rural									
Urban	16,483	0.98	0.40	0.63	0.78	0.96	1.13	1.32	1.84
Rural	4,156	0.95	0.43	0.63	0.77	0.93	1.09	1.28	1.75
Unknown	3	0.95	0.80	0.80	0.80	1.03	1.04	1.04	1.04
Census Region									
Northeast	3,858	0.98	0.38	0.62	0.79	0.97	1.15	1.33	1.85
Midwest	3,589	0.99	0.43	0.66	0.82	0.98	1.14	1.32	1.72
South	9,174	0.97	0.42	0.63	0.78	0.95	1.12	1.31	1.85
West	3,945	0.95	0.41	0.60	0.75	0.93	1.11	1.32	1.84
Unknown	76	0.63	0.16	0.35	0.42	0.56	0.79	1.03	1.73
Census Division									
New England	890	1.05	0.47	0.71	0.87	1.04	1.19	1.37	1.88
Middle Atlantic	2,968	0.97	0.38	0.60	0.77	0.95	1.13	1.32	1.82
East North Central	2,775	0.98	0.43	0.65	0.82	0.97	1.14	1.32	1.72
West North Central	814	1.00	0.44	0.69	0.83	0.99	1.15	1.32	1.72
South Atlantic	4,923	0.96	0.41	0.63	0.77	0.94	1.10	1.29	1.81
East South Central	1,687	0.94	0.44	0.63	0.77	0.93	1.08	1.25	1.72
West South Central	2,564	1.01	0.42	0.65	0.81	0.99	1.17	1.37	1.94
Mountain	1,307	0.94	0.46	0.64	0.76	0.91	1.08	1.27	1.77
Pacific	2,638	0.95	0.39	0.59	0.74	0.93	1.12	1.35	1.88
Unknown	76	0.63	0.16	0.35	0.42	0.56	0.79	1.03	1.73
TIN risk score decile									
1st	2,064	0.95	0.33	0.54	0.70	0.91	1.13	1.39	2.07
2nd	2,064	0.90	0.35	0.55	0.68	0.85	1.06	1.29	1.82
3rd	2,064	0.90	0.40	0.57	0.71	0.87	1.04	1.24	1.80
4th	2,065	0.92	0.39	0.60	0.74	0.90	1.06	1.24	1.70
5th	2,064	0.96	0.44	0.64	0.79	0.94	1.09	1.27	1.78
6th	2,064	0.96	0.46	0.67	0.81	0.95	1.09	1.26	1.72
7th	2,065	0.98	0.45	0.67	0.81	0.97	1.11	1.27	1.66
8th	2,064	1.01	0.49	0.70	0.84	1.00	1.15	1.31	1.79
9th	2,064	1.05	0.52	0.72	0.87	1.03	1.19	1.38	1.91
10th	2,064	1.09	0.54	0.77	0.92	1.07	1.24	1.42	1.90
Number of episodes									
10-19 Episodes	0	-	-	-	-	-	-	-	-
20-39 Episodes	8,670	0.97	0.38	0.58	0.73	0.93	1.16	1.40	2.00
40-59 Episodes	3,705	0.95	0.41	0.61	0.75	0.93	1.12	1.31	1.74
60-79 Episodes	1,937	0.95	0.41	0.63	0.77	0.92	1.10	1.28	1.70
80-99 Episodes	1,217	0.97	0.47	0.67	0.80	0.95	1.12	1.29	1.72
100-199 Episodes	2,412	0.97	0.49	0.70	0.83	0.96	1.11	1.25	1.58
200-299 Episodes	874	1.00	0.57	0.77	0.87	0.99	1.11	1.23	1.48
300+ Episodes	1,827	1.02	0.69	0.86	0.93	1.02	1.10	1.19	1.40

Table 5-B: Asthma/COPD TIN-NPI Cost Measure O/E Ratios

Characteristic	# of TIN-NPIs	Mean O/E Ratio	O/E Ratio Percentile						
			1st	10th	25th	50th	75th	90th	99th
All TIN-NPIs	44,430	0.97	0.40	0.60	0.75	0.94	1.15	1.36	1.91
Sub-group									
Asthma	41,085	0.96	0.12	0.35	0.53	0.79	1.16	1.68	3.95
Both Asthma and COPD	43,499	0.97	0.15	0.38	0.56	0.84	1.19	1.67	3.34
COPD	43,994	0.98	0.29	0.53	0.71	0.94	1.18	1.45	2.28
Urban/Rural									
Urban	36,572	0.98	0.40	0.61	0.76	0.95	1.16	1.37	1.93
Rural	7,855	0.95	0.42	0.60	0.74	0.91	1.12	1.33	1.84
Unknown	3	0.98	0.81	0.81	0.81	1.03	1.10	1.10	1.10
Census Region									
Northeast	8,345	0.99	0.39	0.61	0.77	0.96	1.17	1.39	1.96
Midwest	9,622	1.00	0.42	0.63	0.78	0.97	1.18	1.38	1.90
South	19,539	0.96	0.41	0.60	0.75	0.94	1.14	1.34	1.89
West	6,841	0.95	0.40	0.59	0.73	0.91	1.12	1.34	1.96
Unknown	83	0.63	0.16	0.36	0.42	0.52	0.79	1.02	1.97
Census Division									
New England	2,453	1.04	0.45	0.66	0.82	1.02	1.22	1.44	2.01
Middle Atlantic	5,892	0.97	0.38	0.59	0.75	0.94	1.15	1.37	1.95
East North Central	7,096	0.99	0.42	0.62	0.78	0.97	1.17	1.37	1.89
West North Central	2,526	1.01	0.42	0.64	0.79	0.99	1.19	1.39	1.95
South Atlantic	11,085	0.96	0.41	0.60	0.74	0.93	1.12	1.33	1.88
East South Central	3,681	0.95	0.40	0.58	0.73	0.93	1.12	1.34	1.81
West South Central	4,773	0.99	0.42	0.63	0.77	0.98	1.18	1.38	1.92
Mountain	2,573	0.94	0.42	0.59	0.73	0.90	1.10	1.31	1.93
Pacific	4,268	0.96	0.38	0.58	0.73	0.93	1.13	1.36	1.96
Unknown	83	0.63	0.16	0.36	0.42	0.52	0.79	1.02	1.97
TIN-NPI risk score decile									
1st	4,443	0.96	0.33	0.53	0.69	0.90	1.16	1.43	2.25
2nd	4,443	0.88	0.37	0.54	0.66	0.83	1.05	1.29	1.89
3rd	4,443	0.90	0.38	0.56	0.69	0.85	1.06	1.29	1.81
4th	4,443	0.91	0.40	0.57	0.71	0.88	1.07	1.28	1.82
5th	4,443	0.95	0.41	0.60	0.74	0.93	1.12	1.33	1.79
6th	4,443	0.98	0.44	0.63	0.77	0.95	1.14	1.35	1.85
7th	4,443	1.00	0.44	0.65	0.80	0.99	1.16	1.36	1.90
8th	4,443	1.02	0.47	0.68	0.83	1.01	1.19	1.36	1.81
9th	4,443	1.05	0.49	0.71	0.85	1.03	1.21	1.41	1.90
10th	4,443	1.08	0.51	0.74	0.88	1.06	1.25	1.47	1.92
Number of episodes									
10-19 Episodes	0	-	-	-	-	-	-	-	-
20-39 Episodes	27,206	0.96	0.39	0.58	0.72	0.91	1.15	1.40	2.01
40-59 Episodes	7,818	0.96	0.43	0.62	0.76	0.93	1.13	1.32	1.79
60-79 Episodes	3,281	0.98	0.44	0.64	0.78	0.95	1.15	1.33	1.78
80-99 Episodes	1,820	1.01	0.47	0.69	0.84	0.99	1.17	1.34	1.70
100-199 Episodes	3,162	1.05	0.49	0.76	0.91	1.06	1.18	1.32	1.59
200-299 Episodes	807	1.06	0.60	0.85	0.95	1.05	1.17	1.28	1.50
300+ Episodes	336	1.03	0.48	0.85	0.93	1.03	1.14	1.25	1.46

3.5.3 Interpretation

The results in Tables 5-A and 5-B above indicate that there is no notable variation in the mean cost measure O/E cost ratio across episode sub-groups, urban/rural divide, census regions, or episode volume at both the TIN and TIN-NPI levels. For each characteristic, the largest difference in the mean O/E cost ratio across categories was 0.07 or less. The only exception was census division at the TIN and TIN-NPI levels with some/moderate variation in the mean O/E cost ratio of 0.11 and 0.10, respectively. Generally, this indicates that the risk adjustment model is overall functioning as intended; it is adjusting cost performance such that there are no substantive differences across the categories for these characteristics. For sub-groups, the model is run separately for each sub-group to account for a more fair comparison across episodes in the Asthma, COPD, and both Asthma and COPD sub-groups. These results also support that there is meaningful variation in cost performance, even after risk adjustment, across these characteristics. Overall, these results indicate that there is large potential for saving Medicare spending and that there are generally no systemic differences across geographic region, sub-groups, and case volume.

For TIN or TIN-NPI risk score decile, the difference in mean O/E cost ratio across categories was 0.19 at the TIN level (range: 0.90 to 1.09) and 0.20 at the TIN-NPI level (range: 0.88 to 1.08). The lower values within the ranges of measure scores by risk score decile generally appear in the lower risk deciles at the TIN and TIN-NPI levels, and the higher values appear in the higher risk deciles at the TIN and TIN-NPI levels. This means that at both reporting levels, as the TIN or TIN-NPI risk score decile increases, the mean O/E cost ratio also increases. This variation indicates that the current risk adjustment model may not adequately capture the impact of certain risk factors on clinician or clinician group performance, particularly among clinicians or clinician groups with especially low- and high-risk patient populations. As previously mentioned, we will continue to investigate ways to improve the risk adjustment model's predictive abilities after the field testing period.

3.6 Missing Data Analysis and Minimizing Bias

3.6.1 Method

Since CMS uses Medicare claims data to calculate the Asthma/COPD measure, Acumen expects a high degree of data completeness. To further ensure that we have complete and accurate data for each patient who opens an episode, Acumen excludes episodes where the patient was not found in the Medicare EDB, the patient resided outside of the United States or its territories during the episode window, or the patient was covered by the RRB.

The Asthma/COPD measure also excludes episodes where the patient is enrolled in Medicare Part C or has a primary payer other than Medicare in the 120-day lookback period and episode window. In such situations, Medicare Parts A and B claims data may not capture the complete clinical profile for the patient needed to capture the clinical risk of the patient in risk adjustment. Furthermore, Parts A and B claims data may not capture all Medicare resource use if some portion of the patient's care is covered under Medicare Part C.

3.6.2 Missing Data Analysis

Table 6 below presents the frequency of missing data across the 5 categories of missing data which caused episodes to be excluded from the Asthma/COPD measure. Frequency is presented in terms of the number of episodes excluded due to missing data, as well as the number of TINs and TIN-NPIs who had at least one episode excluded due to missing data. The missing data categories are:

- Patient was not found in the Medicare EDB
- Patient has a primary payer other than Medicare during the episode window or in the 120-day lookback period
- Patient was not enrolled in Medicare Parts A and B, or was enrolled in Part C, during the 120-day lookback period and episode window
- Patient resided outside of the United States or its territories during the episode window
- Patient was covered by the RRB

Table 6: Missing Data Categories for the Asthma/COPD Measure

Exclusion	# Episodes	# TINs	# TIN-NPIs
Not Found in Medicare EDB	*	*	*
Other Primary Payer	482,520	41,391	164,085
Not Continuously Enrolled	465,333	41,081	158,962
Resided Outside of U.S. or Territories	4,521	2,950	4,981
Covered by RRB	40,084	10,893	29,723

*Indicates that there were fewer than 11 episodes.

3.6.3 Interpretation

As the Asthma/COPD measure is calculated with Medicare claims data, Acumen expects a high degree of data completeness, which is supported by the limited frequency (relative to the overall scale of this measure) of missing data as noted above. Acumen takes measures to ensure that missing or inaccurate information in claims data is not included in the cost measure.

Other Additional Information

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The Asthma/COPD Clinician Expert Workgroup is composed from the larger Chronic Condition and Disease Management Clinical Subcommittee. The composition list of the Clinical Subcommittee is included in the Episode-Based Cost Measures Development Process document.[76]

[76] CMS, "2020 Episode-Based Cost Measures Field Testing Wave 3 Measure Development Process," MACRA Feedback Page, https://www.cms.gov/files/document/macra-cmft-ebcm-process-2020.pdf.