Quality Payment
PROGRAM

Colon and Rectal Resection

Measure Testing Form

Summer 2020 Field Testing

Contents

1.0 Introduction

This Measure Testing Form provides results for the testing of the Colon and Rectal Resection 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. 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 Colon and Rectal Resection 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 (including Colon and Rectal Resection) and 20 episodes for chronic condition episode groups. 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 Colon and Rectal Resection 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, "Cost Measure Field Testing", 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 Colon and Rectal Resection cost measure evaluates clinicians and clinician groups risk-adjusted cost to Medicare for patients who receive colon or rectal resections for either benign or malignant indications. The measure score is a clinician or clinician group's average risk-adjusted cost across all attributed episodes for the episode group. This procedural measure includes services that are clinically related and under the reasonable influence of the attributed clinician during the 15 days prior to the resection procedure that opens or "triggers" the episode and the 90 days after the procedure. 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's focus represents an area where there are opportunities for improvement. Primary opportunities for improvement include selecting the appropriate modality of surgery and adopting prevention strategies to mitigate the risk of common postoperative complications.

A clinician's selected method to performing a colorectal surgery has a significant impact on patient outcomes. Colorectal surgery can be performed using 3 different modalities: open, laparoscopic, and robotic. The benefits of performing colon resections laparoscopically or robotically are well established. These minimally invasive approaches are associated with reduced lengths of stay, reduced utilization of post-acute care, lower postoperative readmission rates, and lower mortality rates, especially among the older adult population.[7,8] Although the use of such techniques may be more limited in scope for rectal resections due to added technical complexity, recent studies indicate that these techniques may also have a role in reducing postoperative complications following surgery for rectal cancer treatment. Specifically, studies and reviews of meta-analyses have demonstrated that robotic or laparoscopic surgery for rectal cancer treatment may reduce the incidence of postoperative complications when compared to

[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]Umashankkar Kannan et al., "Laparoscopic vs Open Partial Colectomy in Elderly Patients: Insights from the American College of Surgeons - National Surgical Quality Improvement Program Database," World Journal of Gastroenterology 21, no. 45 (December 7, 2015): 12843–50, https://doi.org/10.3748/wjg.v21.i45.12843.
[8]Cigdem Benlice et al., "Robotic, Laparoscopic, and Open Colectomy: A Case-Matched Comparison from the ACS-NSQIP," International Journal of Medical Robotics and Computer Assisted Surgery 13, no. 3 (September 1, 2017), https://doi.org/10.1002/rcs.1783.

open surgery.[9,10,11,12] There remains wide variation in the utilization of open surgery, laparoscopic, and robotic approaches for different diagnoses.[13] In 2012, open surgeries constituted 65.4% of all colorectal surgeries nationwide, while 31.2% and 3.4% were performed using laparoscopic or robotic techniques, respectively.[14] Efforts to increase adoption of minimally invasive techniques, when appropriate, through surgeon education and training could be effective strategies to curb costs associated with prolonged lengths of stay and readmission.

Colorectal resection accounts for a substantial share of postoperative readmissions among inpatient procedures, with one study approximating a 30-day postoperative readmission rate of 13.7%.[15,16,17] Estimates of the inpatient cost for readmission following colorectal surgery range from $9,000 to $12,000 across studies.[18] One study estimates that readmissions associated with colorectal surgery account for approximately $300 million in costs annually across the nation.[19] Postoperative readmission is strongly associated with the occurrence of common complications such as surgical site infection (SSI), ileus, and urinary tract infections. Occurrence of SSI alone is estimated to contribute an additional estimated cost of $40,500 per patient and an estimated national total of $3 billion per year.[20] Applying prevention strategies to emergency colorectal surgeries based on clinical guidelines for an "Enhanced Recovery After Surgery" (ERAS) protocol can decrease these post-operative complications and reduce morbidity. ERAS is a standard of perioperative care for elective colorectal surgeries; however, there appears to

[9]Carly R. Richards et al., "Safe Surgery in the Elderly: A Review of Outcomes Following Robotic Proctectomy from the Nationwide Inpatient Sample in a Cross-Sectional Study," Annals of Medicine and Surgery 44 (2019/08/01/ 2019), https://doi.org/10.1016/j.amsu.2019.06.004; S. A. Antoniou et al., "Laparoscopic Colorectal Surgery Confers Lower Mortality in the Elderly: A Systematic Review and Meta-Analysis of 66,483 Patients," Surg Endosc 29, no. 2 (Feb 2015), https://doi.org/10.1007/s00464-014-3672-x.
[10]C. Simillis et al., "Open Versus Laparoscopic Versus Robotic Versus Transanal Mesorectal Excision for Rectal Cancer: A Systematic Review and Network Meta-Analysis," Ann Surg 270, no. 1 (Jul 2019), https://doi.org/10.1097/SLA.0000000000003227; Antonio Biondi et al., "Laparoscopic Vs. Open Approach for Colorectal Cancer: Evolution over Time of Minimal Invasive Surgery," BMC surgery 13 Suppl 2, no. Suppl 2 (2013), https://doi.org/10.1186/1471-2482-13-S2-S12; D. L. Waitzberg et al., "Postsurgical Infections Are Reduced with Specialized Nutrition Support," World J Surg 30, no. 8 (Aug 2006), https://doi.org/10.1007/s00268-005-0657-x.
[11]Meng Tse Gabriel Lee et al., "Trends and Outcomes of Surgical Treatment for Colorectal Cancer between 2004 and 2012- An Analysis Using National Inpatient Database," Scientific Reports 7, no. 1 (December 1, 2017), https://doi.org/10.1038/s41598-017-02224-y.
[12]Zhong Lin et al., "Short- and Long-Term Outcomes of Laparoscopic versus Open Surgery for Rectal Cancer: A Systematic Review and Meta-Analysis of Randomized Controlled Trials," Medicine (United States) (Lippincott Williams and Wilkins, December 1, 2018), https://doi.org/10.1097/MD.0000000000013704.
[13]Philipp Kirchhoff, Pierre Alain Clavien, and Dieter Hahnloser, "Complications in Colorectal Surgery: Risk Factors and Preventive Strategies," Patient Safety in Surgery (BioMed Central, March 25, 2010), https://doi.org/10.1186/1754-9493-4-5.
[14]Meng Tse Gabriel Lee et al., "Trends and Outcomes of Surgical Treatment for Colorectal Cancer between 2004 and 2012- An Analysis Using National Inpatient Database."
[15]John D. Birkmeyer et al., "Medicare Payments for Common Inpatient Procedures: Implications for Episode-Based Payment Bundling," Health Services Research 45, no. 6 PART 1 (2010): 1783–95, https://doi.org/10.1111/j.1475-6773.2010.01150.x.
[16]Elizabeth C. Wick et al., "Readmission Rates and Cost Following Colorectal Surgery," Diseases of the Colon and Rectum 54, no. 12 (December 2011): 1475–79, https://doi.org/10.1097/DCR.0b013e31822ff8f0.
[17]Rachelle N. Damle et al., "Clinical and Financial Impact of Hospital Readmissions after Colorectal Resection: Predictors, Outcomes, and Costs," Diseases of the Colon and Rectum 57, no. 12 (December 2014): 1421–29, https://doi.org/10.1097/DCR.0000000000000251.
[18]Birkmeyer et al., "Medicare Payments for Common Inpatient Procedures: Implications for Episode-Based Payment Bundling"; Wick et al., "Readmission Rates and Cost Following Colorectal Surgery"; Damle et al., "Clinical and Financial Impact of Hospital Readmissions after Colorectal Resection: Predictors, Outcomes, and Costs."
[19]Wick et al., "Readmission Rates and Cost Following Colorectal Surgery."
[20]Megan C. Turner and John Migaly, "Surgical Site Infection: The Clinical and Economic Impact," Clinics in Colon and Rectal Surgery 32, no. 3 (May 2019): 157–65, https://doi.org/10.1055/s-0038-1677002.

be low implementation of an ERAS protocol in emergent settings. This may be due to the fact that patients undergoing emergent surgeries have more risk factors and comorbidities that must be managed.[21] Expanding the implementation of ERAS protocols has the potential to improve overall quality of care and reduce related services and their associated costs.

A diverting stoma, in which a surgeon externally diverts the flow of feces may be another avenue to mitigate common complications such as anastomotic leaks and the associated costs.[22,23] Although there are benefits and tradeoffs to fecal diversion to protect an anastomosis, certain factors may indicate cases in which a diverting stoma may be the preferred surgical approach. For example, there is generally a consensus among researchers that the presence of a diverting stoma lowers the risk of anastomotic leak and can lower the risk of developing pelvic sepsis for patients who undergo a low anterior resection.[24,25,26,27] Since the risks associated with diverting stomas are well documented, preventative pathways have been developed to address the potential for dehydration and other common causes of readmission due to colorectal surgeries.[28] For example, one study reported reducing the rate of hospital readmissions and entirely eliminating readmissions related to dehydration by employing an educational intervention for patients with new, temporary or permanent ileostomies.[29] This suggests that coupling diverting stomas with robust patient education may result in improved outcomes following colorectal surgery. Fecal diversion is also demonstrated to have a protective effect in terms of decreased mortality and morbidity for other high-risk cases. For example, recent studies have identified primary anastomosis with diversion as the preferred option for cases with active infections, such as peritonitis from diverticular disease, compared to Hartmann's procedure.[30] As such, diversions may play an important role in improving outcomes and reducing associated downstream costs for select high-risk colorectal cases.

[21]Varut Lohsiriwat and Romyen Jitmungngan, "Enhanced Recovery after Surgery in Emergency Colorectal Surgery: Review of Literature and Current Practices," World Journal of Gastrointestinal Surgery 11, no. 2 (February 27, 2019): 41–52, https://doi.org/10.4240/wjgs.v11.i2.41.
[22]Silvia Palmisano et al., "Diverting Stoma," in Rectal Cancer (Springer, Milano, 2013), 131–37, https://doi.org/10.1007/978-88-470-2670-4_10.
[23]AL Peel and EW Taylor, "Proposed Definitions for the Audit of Postoperative Infection: A Discussion Paper. Surgical Infection Study Group.," Annals of the Royal College of Surgeons of England 73, no. 6 (March 1991): 385–88.
[24]Jeremy Meyer et al., "Reducing Anastomotic Leak in Colorectal Surgery: The Old Dogmas and the New Challenges," World Journal of Gastroenterology (Baishideng Publishing Group Co., Limited, September 14, 2019), https://doi.org/10.3748/wjg.v25.i34.5017.
[25]Kirchhoff, Clavien, and Hahnloser, "Complications in Colorectal Surgery: Risk Factors and Preventive Strategies."
[26]Scott R Steele et al., "Improving Outcomes and Cost-Effectiveness of Colorectal Surgery," n.d., https://doi.org/10.1007/s11605-014-2643-9.
[27]Alexis Plasencia and Heidi Bahna, "Diverting Ostomy: For Whom, When, What, Where, and Why," Clinics in Colon and Rectal Surgery 32, no. 3 (May 2019): 171–75, https://doi.org/10.1055/s-0038-1677004.
[28]Steele et al., "Improving Outcomes and Cost-Effectiveness of Colorectal Surgery."
[29]Deborah Nagle et al., "Ileostomy Pathway Virtually Eliminates Readmissions for Dehydration in New Ostomates," Diseases of the Colon and Rectum 55, no. 12 (December 2012): 1266–72, https://doi.org/10.1097/DCR.0b013e31827080c1.
[30] Amy L. Lightner and John H. Pemberton, "The Role of Temporary Fecal Diversion," Clinics in Colon and Rectal Surgery 30, no. 3 (July 1, 2017): 178–83, https://doi.org/10.1055/s-0037-1598158; Valerie Bridoux et al., "Hartmann's Procedure or Primary Anastomosis for Generalized Peritonitis Due to Perforated Diverticulitis: A Prospective Multicenter Randomized Trial (DIVERTI)," Journal of the American College of Surgeons 225, no. 6 (December 1, 2017): 798–805, https://doi.org/10.1016/j.jamcollsurg.2017.09.004; Plasencia and Bahna, "Diverting Ostomy: For Whom, When, What, Where, and Why."

2.2 Performance Gap

2.2.1 Rationale

Colorectal resection, or colectomy, is a common treatment for colorectal cancer and complications related to diverticular disease. According to the Agency for Healthcare Research and Quality, about 320,000 colorectal resection procedures were performed annually between 2001 and 2011.[31] Colorectal cancer is the second leading cause of cancer-related deaths and the third most common cancer in both men and women in the United States. Colorectal cancer is especially common in the 85 and older adult population, with an incidence of 237 per 100,000 persons in 2016.[32] Similarly, diverticular disease primarily affects older adults, occurring in 50 to 70% of those aged 80 or older. Diverticular disease accounts for more than $2 billion in treatment costs annually. While diverticular disease is usually an asymptomatic condition, the incidence of complications, such as colonic diverticulitis, increases with age.[33,34] Morbidity and the risk of postoperative complications following colorectal resection also increase significantly for patients above age 65.[35] According to the literature, a single colectomy is estimated to cost $25,000, and this cost can increase to nearly $50,000 with post-operative complications.[36,37] Estimates of index hospitalization costs for colorectal surgery are similar and have been shown to range between about $18,000 to $21,000 among a cohort of Medicare patients, with variation in the cost of care provided within a year of the surgery largely driven by readmissions and post-acute care utilization.[38] Given the variation and frequency of treating colorectal cancer and complications related to diverticular disease with colectomy procedures in Medicare patients, the Colon and Rectal Resection cost measure represents an opportunity for improvement on overall cost performance.

The Colon and Rectal Resection episode-based cost measure was recommended for development by an expert clinician committee—the General and Colorectal Surgery 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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[31]Audrey J Weiss and Anne Elixhauser, Trends in Operating Room Procedures in U.S. Hospitals, 2001–2011: Statistical Brief #171, Healthcare Cost and Utilization Project (HCUP) Statistical Briefs (Rockville, MD: Agency for Healthcare Research and Quality, 2014), http://www.ncbi.nlm.nih.gov/pubmed/24851286; Samuel Eisenstein, Sarah Stringfield, and Stefan D. Holubar, "Using the National Surgical Quality Improvement Project (NSQIP) to Perform Clinical Research in Colon and Rectal Surgery," Clinics in Colon and Rectal Surgery 32, no. 1 (2019): 41–53, https://doi.org/10.1055/s-0038-1673353.

[32]U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, and National Cancer Institute, "U.S. Cancer Statistics Data Visualizations Tool," n.d., https://gis.cdc.gov/Cancer/USCS/DataViz.html.

[33]Chien Kuo Liu, Hsi Hsien Hsu, and She Meng Cheng, "Colonic Diverticulitis in the Elderly," International Journal of Gerontology (Elsevier (Singapore) Pte Ltd, March 1, 2009), https://doi.org/10.1016/S1873-9598(09)70015-8.

[34]Neda Valizadeh, Kunal Suradkar, and Ravi P Kiran, "Specific Factors Predict the Risk for Urgent and Emergent Colectomy in Patients Undergoing Surgery for Diverticulitis," The American Surgeon 84, no. 11 (November 1, 2018): 1781–86,http://www.ncbi.nlm.nih.gov/pubmed/30747633.

[35]Mehraneh D. Jafari et al., "Colorectal Cancer Resections in the Aging US Population: A Trend toward Decreasing Rates and Improved Outcomes," JAMA Surgery (American Medical Association, June 1, 2014), https://doi.org/10.1001/jamasurg.2013.4930.

[36]Faiz Gani et al., "Bundled Payments for Surgical Colectomy among Medicare Enrollees: Potential Savings vs the Need for Further Reform," JAMA Surgery 151, no. 5 (May 1, 2016): e160202, https://doi.org/10.1001/jamasurg.2016.0202.

[37]David N Flynn et al., "The Impact of Complications Following Open Colectomy on Hospital Finances: A Retrospective Cohort Study," Perioperative Medicine 3, no. 1 (March 7, 2014): 1, https://doi.org/10.1186/2047-0525-3-1.

[38]Zaid M. Abdelsattar, John D. Birkmeyer, and Sandra L. Wong, "Variation in Medicare Payments for Colorectal Cancer Surgery," Journal of Oncology Practice 11, no. 5 (September 30, 2015): 391–95, https://doi.org/10.1200/jop.2015.004036.

2.2.2 Performance Scores

To demonstrate the performance gap captured in the measure, Table 1 below presents a distribution of performance scores for 1,422 clinician group practices and 1,993 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 Alternate Payment Model participation). This table uses a testing volume threshold of 10 episodes.

Table 1. Distribution of Performance Scores

Metric	TIN	TIN-NPI
Mean score	$24,826	$24,618
Score Interquartile Range (IQR)	$2,739	$3,010
Score percentile		
10th	$22,254	$21,765
25th	$23,271	$22,920
50th	$24,536	$24,271
75th	$26,010	$25,930
90th	$27,694	$27,790

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 Colon and Rectal Resection measure uses Medicare Part A and Part B claims data maintained by CMS. Parts A and B claims data are used to build episodes of care, calculate episode costs, and construct risk adjustors. 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

Colon and Rectal Resection 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 4,838 clinician group practices and 18,733 practitioners, which includes any clinician groups/practitioners who had at least one Colon and Rectal Resection episode in the measurement period. After applying exclusions and the case minimum, the final population for testing and analyses included 1,422 clinician group practices and 1,993 practitioners who were attributed 10 or more Colon and Rectal Resection episodes during the measurement period. Episodes from all 50 States and the District of Columbia triggered in the following settings were included:

- Ambulatory surgery center (ASC);
- Hospital outpatient department (HOPD); and
- Hospital inpatient acute care facility

3.1.6 Patient Cohort Included in the Testing and Analysis

56,002 Medicare patients, with a mean age of 73.78, (from 56,266 episodes) were included in measure testing and analyses (where patient populations are not subject to any case minimum restrictions).

The patient population for the Colon and Rectal Resection measure calculation consists of Medicare beneficiaries enrolled in Medicare Parts A and B (but not Part C) who undergo a procedure for colon or rectal resections for either benign or malignant indications that trigger a Colon and Rectal Resection episode, as identified by the trigger Current Procedural Terminology/Healthcare Common Procedure Coding System (CPT/HCPCS) code(s) on Part B Physician/Supplier claims. If the procedure occurs in an inpatient setting, the concurrent inpatient stay must have a relevant admission (defined as an inpatient claim with Medicare Severity-Diagnosis Related Group [MS-DRG] 329-334). 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 who undergo procedures for colon or rectal resections for either benign or malignant indications.

The exclusion criteria are:

- The patient has a primary payer other than Medicare for any time overlapping the episode window or in the 120-day lookback period prior to the trigger day.
- The patient was not enrolled in Medicare Parts A and B for the entirety of the 120-day lookback period plus episode window, or was enrolled in Part C for any part of the lookback plus episode window.
- The episode cannot be attributed to a main surgeon.
- The patient death date occurs before the inpatient (IP) admission.
- The patient death occurs before the end of episode.
- The episode trigger claim was not performed in an Outpatient (OP) hospital, IP hospital, or ASC setting based on its place of service.
- The episode trigger claim occurred in an IP facility that was not a short-term stay acute hospital, as defined by subsection (d).[39]
- The episode trigger claim was less than one dollar.
- Where there is a concurrent inpatient stay with the trigger, the inpatient stay does not have a MS-DRG related to colon and rectal resections (i.e., MS-DRGs 329-334).
- The episode is an outlier case.
- The patient was transferred within 3 days prior to an IP admission.
- The patient had a recent major bowel surgery.
- The patient elected to leave against medical advice.
- The patient received a Left Ventricular Assist Device (LVAD).

To determine whether the Colon and Rectal Resection 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 Colon and Rectal Resection measure's exclusion criteria have a minimal to moderate effect on the percentage of patients of any particular demographic category. The difference between patients being excluded and included in the measure is less than 3.81 percentage points across each of the characteristics in the analysis at TIN level

[39] Only stays at IP facilities that are paid under a short-term stay acute hospital as defined by subsection (d) will be included. Subsection (d) hospitals are hospitals in the 50 states and D.C. other than: psychiatric hospitals, rehabilitation hospitals, hospitals whose inpatients are predominantly under 18 years old, hospitals whose average inpatient length of stay exceeds 25 days, and hospitals involved extensively in treatment for or research on cancer. For details on the identification of these hospitals, please refer to the CCN definitions for Short-term (General and Specialty) Hospitals facility types in Chapter 2, Section 2779A1 of the CMS State Operation Manual.

testing, and less than 5.47 percentage points at TIN-NPI level testing. The one exception to these results is HCC11 for, "Colorectal, Bladder, and Other Cancers," where the difference between patients being included in the measure is 6.24 percentage points at the TIN level and 10.04 percentage points at the TIN-NPI level. These results are expected given the Colon and Rectal Resection measure's intent to focus on patients who undergo a procedure for colon or rectal resections for either benign or malignant indications. The percentage of patients aged 65 to 69 is 22.96% without applying the exclusion criteria, compared to 23.32% at TIN level testing once exclusions are applied. Furthermore, the difference in the percentage of patients across race categories with and without the exclusion criteria is less than 2.52 percentage points at both the TIN and TIN-NPI levels of testing. When comparing the breakdown of male and female patients at the TIN-NPI level, there is a difference of 1.15 percentage points between the female and male patient populations with and without exclusion criteria. Similarly, at TIN level testing, there is a difference of 0.61 percentage points between the share of male and female patients. These results indicate that there is a minimal to moderate shift in patient characteristics as a result of using the exclusion criteria listed above at both TIN and TIN-NPI levels of 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, and 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[40]

[40] 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 Colon and Rectal Resection 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 General and Colorectal Surgery Clinical Subcommittee;
(ii) a Colon and Rectal Resection 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.[41]

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 performing colon and rectal resections, thus limiting cost variation unrelated to clinician care for this measure. Assigned services occurring in the emergency department, outpatient facility and clinician services, inpatient medical, inpatient surgical, inpatient rehabilitation facility, and home health settings were defined separately for the pre- and post-trigger windows, and include colon and rectal resection evaluation, testing, treatment, complications, and follow-up.

Empirical Validity Testing

We undertook two approaches to estimate the measure's validity. In the first approach, we evaluated the empirical validity of the Colon and Rectal Resection measure by examining correlation with known indicators of resource or service utilization based on a literature review, specifically complications related to colon and rectal resections. For this analysis, we compared the ratio of observed over expected cost (O/E cost ratios) at the provider level for Colon and Rectal Resection episodes with and without complications occurring in the post-trigger period. This analysis sought to confirm the expectation that the Colon and Rectal Resection measure captures variation in service utilization as an indicator of clinician cost performance. We would expect episodes with post-trigger complications, including downstream acute readmissions and post-acute care in an inpatient rehabilitation facility (IRF), skilled nursing facility (SNF), home health (HH), or long-term care hospital (LTCH), would have higher 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

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

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 Colon and Rectal Resection measure were classified into clinically coherent groups of services, called "clinical themes." The Colon and Rectal Resection measure clinical themes are:

- **Trigger Procedure and Procedures During the Trigger Stay or Day**: Includes services occurring during the inpatient stay for trigger procedures performed during a hospital admission or during the day of the trigger procedure for outpatient surgeries.
- **Pre-Operative Evaluation Services:** Includes outpatient procedures such as pre-operative lab testing and imaging as well as evaluations by the surgeon, anesthesiology, and other practitioners to prepare a patient for the surgery.
- **Routine Post-Operative Care:** Includes inpatient and outpatient care for the condition leading to the surgery (e.g., Crohn's disease) occurring within a limited post-operative timeframe, routine outpatient follow-up procedures such as imaging, and durable medical equipment (DME) for routine wound care, ostomy supplies, and parenteral nutrition if considered an expected consequence of the surgery.
- **Post-Operative Complications:** Includes inpatient and outpatient procedures and DME used to treat complications such as infections, bleeding, wound complications, cardiopulmonary complications, and renal failure.
- **Post-Acute Care and Post-Operative Rehabilitation**: Includes SNF care, HH, or care in the post-acute settings following the trigger procedure, outpatient physical and occupational therapy, and DME related to post-operative care.

As with the first analysis for validity, the aim of this analysis was to determine whether the measure is capturing variation in provider cost in the manner intended and expected. To measure this, we calculated the Pearson correlation between the cost of each clinical theme and the overall risk-adjusted cost for an episode.

We would expect that clinical themes for complications (i.e., the Post-Operative Complications theme) would have the highest correlation with risk-adjusted cost, as complications are likely associated with high costs, even after accounting for patient characteristics.[42] We would expect a similar trend for the Post-Acute Care and Post-Operative Rehabilitation theme as it contains services that are related to post-operative complications, including physical and occupational therapy. By contrast, we would expect that Pre-Operative Evaluation Services and Routine Post-Operative Care themes have lower cost correlations, as these services are generally low cost (even after risk adjustment) and do not have a considerable amount of cost variation in comparison to the complications-related themes.

3.2.3 Statistical Results from Validity Testing

Table 2 below presents the results from the first analysis of validity. The mean O/E ratio for all episodes is 1.01. The mean O/E ratio for episodes with services relating to complications during the post-trigger period is 1.33, compared with 0.98 for episodes without services relating to complications during the post-trigger period.

[42] Khan, N.A., Quan, H., Bugar, J.M. et al., "Association of postoperative complications with hospital costs and length of stay in a tertiary care center" J Gen Intern Med (2006) 21: 177.

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	1.01	0.37	0.42	0.66	0.73	0.81	0.93	1.10	1.40	1.69	2.45
Episodes with Downstream Acute Readmission	1.50	0.62	0.70	0.87	0.95	1.11	1.35	1.71	2.24	2.68	3.69
Episodes without Downstream Acute Readmission	0.96	0.28	0.39	0.66	0.72	0.80	0.91	1.04	1.26	1.48	2.02
Episodes with Post-Acute Care (IRF, LTCH, HH, SNF)	1.09	0.43	0.55	0.67	0.73	0.82	0.97	1.22	1.61	1.90	2.68
Episodes without Post-Acute Care (IRF,LTCH, HH, SNF)	0.92	0.25	0.29	0.66	0.72	0.80	0.90	1.01	1.14	1.25	1.73
Episodes with Services Related to Colon and Rectal Resection Complications	1.33	0.60	0.57	0.72	0.79	0.92	1.19	1.58	2.04	2.51	3.42
Episodes without Services Related to Colon and Rectal Resection Complications	0.98	0.31	0.40	0.66	0.72	0.81	0.91	1.06	1.30	1.54	2.14

Table 3 below presents the results from the clinical themes analysis. These results demonstrate that there is a greater correlation between the Post-Acute Care and Post-Operative Rehabilitation (correlation: 0.55) and Post-Operative Complications (correlation: 0.54) themes and risk-adjusted cost. By contrast, the Routine Post-Operative Care (correlation: 0.08) and Pre-Operative Evaluation Services (correlation: 0.05) themes had lower correlation with risk-adjusted cost.

Table 3: Clinical Themes

Clinical Theme	Pearson Correlation With Risk-Adjusted Cost
Trigger Procedure and Procedures During the Trigger Stay or Day	0.12
Pre-Operative Evaluation Services	0.05
Routine Post-Operative Care	0.08
Post-Operative Complications	0.54
Post-Acute Care and Post-Operative Rehabilitation	0.55

3.2.4 Interpretation

As expected, the average O/E cost ratios for episodes with post-trigger complications, including downstream acute readmissions and post-acute care (IRF, LTCH, HH, and SNF) as well, are higher than for episodes without downstream complications. This result demonstrates that the Colon and Rectal Resection 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) will yield higher costs, even after risk adjustment.

The clinical themes analysis demonstrates that high risk-adjusted cost is strongly associated with themes related to complications and weakly correlated with themes relating to preoperative work-up and monitoring, as expected. This indicates that the measure may disincentivize higher rates of costlier complications, while not disincentivizing the provision of appropriate pre- and post-operative care, such as evaluation, imaging, and testing.

3.3 Exclusions Analysis

3.3.1 Method of Testing Exclusions

Exclusions are used in the Colon and Rectal Resection measure to ensure a comparable patient population within the scope of the measure focus on colon or rectal resections for either benign or malignant indications, 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 a patient's death date occurred before the episode end date.
    - These episodes were excluded as they may not accurately reflect a clinician's performance. Episodes where a patient died may be unusually high-cost, due to perimortem treatment costs, or unusually low-cost, due to the truncated episode window. Neither of these cases accurately reflects the efficiency of the clinician performing the treatment.
- Episodes where patients have a LVAD
    - These episodes were excluded because of the limited number of patients who receive an LVAD as well as the limited number of institutions, in which procedures to insert these devices, are performed.
- Episodes where a patient has had a recent major bowel surgery
    - These episodes were excluded because the cohort of patients who undergo a major bowel surgery shortly before the trigger event may indicate that the procedure is staged. Staged procedures as a result of complications and emergent procedures that require staging may have different costs associated with them. However, the costs of subsequent procedures are assigned to the episode if a procedure becomes staged as a result of complications.
- Episodes where a patient elects to leave against medical advice
    - Leaving against medical advice prevents the attributed clinician from completing appropriate care for a patient, which leaves a patient at high risk of further complications. Retaining such patients would put the attributed clinician at risk of being attributed a costly episode in which they did not have the chance to fully treat a patient.
- Episodes where the patient was transferred within 3 days prior to admission
    - These episodes were excluded to avoid incentivizing institutions to transfer or turn away more complex patients.
- 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 O/E ratios (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 Colon and Rectal Resection measure is provided in the draft Measure Codes List available on the MACRA Feedback Page.[43]

3.3.2 Statistical Results from Testing Exclusions

Table 4 below presents observed cost statistics and O/E cost ratios for the Colon and Rectal Resection measure exclusions. Cost statistics are also provided for the set of final episodes included in the Colon and Rectal Resection measure for comparison, with a testing volume threshold of 10 episodes at the TIN and TIN-NPI levels. For the standard exclusions in the table below, such as the trigger claim not occurring in an inpatient prospective payment system, or IPPS, acute hospital or psychiatric facility, the trigger claim was not performed in an OP, IP, ASC setting, and where there is a concurrent inpatient stay with the trigger, the inpatient stay does not have a related MS-DRG (i.e., MS-DRGs 329-334), these patient cohorts were excluded from the measure to assess episodes in the intended setting and by the measure's intended attribution approach.

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	78,201	100.00%	$23,892	$5,967	$45,485	0.99	0.43	1.49
Patient Death in Episode	8,563	10.95%	$27,366	$4,173	$55,781	0.88	0.26	1.56
Not an IPPS Acute Hospital	983	1.26%	$27,006	$12,593	$48,012	1.09	0.72	1.63
Not in OP, IP, or ASC Setting	97	0.12%	$26,497	$4,214	$59,676	1.06	0.29	2.04
No relevant MS-DRG in Episode with Concurrent IP Stay	14,801	18.93%	$11,009	$2,581	$23,088	0.91	.20	2.04
Transfer within 3 days prior to IP admission	1,535	1.96%	$33,855	$4,905	$69,284	1.09	0.29	1.97
Leaving AMA	79	0.10%	$23,289	$5,771	$37,751	1.12	0.44	1.57
Recent Major Bowel Surgery	1,460	1.87%	$29,306	$5,026	$57,816	1.08	0.32	2.12
LVAD	40	0.05%	$24,311	$4,803	$52,954	0.72	0.27	1.03
Outlier cases	1,122	1.43%	$71,009	$17,896	$143,365	1.82	0.40	3.72
Final Episodes (TIN)	47,633	60.91%	$24,113	$12,498	$42,736	0.98	0.71	1.36
Final Episodes (TIN-NPI)	29,237	37.39%	$22,504	$12,431	$38,837	0.98	0.71	1.33

*This table does not include all measure exclusions.

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

3.3.3 Interpretation

The statistical results indicate that the majority of excluded episodes are different than the final set of episodes at the TIN and TIN-NPI levels of testing. The excluded episodes differ in the mean observed cost (e.g., higher observed cost) or in the mean O/E cost ratio and O/E cost ratio distribution. 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 ending in death: Episodes ending in death have a higher observed cost ($27,336) compared to the final set of episodes at the TIN level testing ($24,113) and at the TIN-NPI level testing ($22,504). The mean O/E cost ratio for these episodes (0.88) is substantially lower than the mean O/E cost ratio for final episodes at both TIN-level and TIN-NPI levels of testing (0.98). Finally, the O/E cost ratio ranges from 0.26 at the 10th percentile to 1.56 at the 90th percentile for episodes ending in death, compared to 0.71 at the 10th percentile and 1.36 at the 90th percentile for final episodes at TIN level and 0.71 at the 10th percentile and 1.33 at the 90th percentile for final episodes TIN-NPI level, respectively. These results indicate that this patient cohort is distinct in both observed cost and risk profile, and excluding these episodes ensures a fairer cost comparison.

Episodes where patients have an LVAD: Episodes where patients that have an LVAD are clinically different than episodes where patients do not have an LVAD. There is a limited number of episodes with this patient characteristic (i.e., 40), and a limited number of institutions in which the procedures to insert these devices are performed. The cost profile of episodes where patients have an LVAD also differs, where the distribution of O/E cost ratio ranges from 0.27 at the 10th percentile to 1.03 at the 90th percentile (compared to a narrower range of 0.71 at the 10th percentile to around 1.30 at the 90th percentile for final episodes at TIN and TIN-NPI levels). The very small number of episodes and institutions that insert these devices along with the distinct cost profile for patients that have an LVAD support the exclusion of this patient sub-population from the measure.

Episodes where a patient had a recent major bowel surgery: As expected, based on the clinical justification for the exclusion, costs for episodes where the patient had a recent major bowel surgery are substantially higher (mean observed cost of $29,306) in comparison to the final set of episodes. The mean O/E cost ratio for these episodes is also substantially higher (1.08) than for final episodes at both TIN and TIN-NPI levels of testing (0.98). Finally, the O/E cost ratio ranges from 0.32 at the 10th percentile to 2.12 at the 90th percentile, compared to 0.71 at the 10th percentile and around 1.30 at the 90th percentile for final episodes at TIN and TIN-NPI levels. These results suggest that there is greater variation in costs for patients who have had a recent major bowel surgery, ultimately resulting in higher mean episode costs compared to the final episode group population. These results justify and reflect the clinical rationale for this exclusion.

Episodes where a patient elects to leave against medical advice: This measure is intended to incentivize clinicians to change their behavior and treatment patterns to increase cost-effectiveness. However, the ability of the measure to accurately reflect such improvements is limited if attributed clinicians are held accountable for patients who do not take advantage of the offered care. Although the mean observed costs are similar to the final set of episodes, the mean O/E cost ratio (1.12) is higher than the final set of episodes and the O/E cost ratios range from 0.44 at the 10th percentile to 1.57 at the 90th percentile, compared to a narrower range of 0.71 at the 10th percentile to around1.30 at the 90th percentile for final episodes at the TIN and

TIN-NPI levels. Therefore, these patients are excluded to allow the measure to capture the outcomes of clinicians' decisions.

Episodes where a patient was transferred within 3 days prior to the admission: As expected, these episodes have substantially higher mean observed episode costs ($33,855) compared to the final set of episodes. Additionally, the O/E cost ratios for these episodes range from 0.29 at the 10th percentile to 1.97 at the 90th percentile, a considerably wider range compared to 0.71 at the 10th percentile and around 1.30 at the 90th percentile for final episodes at TIN and TIN-NPI levels. These results suggest that patients who are transferred within 3 days prior to the admission have both higher mean episode costs and greater variation. These results, alongside the intention to avoid incentivizing institutions to transfer or deny care to riskier or more complex patients, support exclusion. This exclusion is also in line with other bundled payment programs.

Episodes classified as outlier cases: The mean observed cost of these episodes is nearly 3 times greater than for the final set of episodes (e.g., $71,009 compared to $24,113 at the TIN-level and $22,504 at the TIN-NPI-level). The mean O/E cost ratio is substantially higher (1.82) compared to both TIN and TIN-NPI levels of testing (i.e., 0.98). In addition, the O/E cost ratio for outlier cases ranges from 0.40 at the 10th percentile to 3.72 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 145 risk factors and stratification by 2 risk categories.

The risk adjustment model for the Colon and Rectal Resection 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 one 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 patient's Parts A and B claims during the period 120 days prior to the episode trigger 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 recent chemotherapy or radiation.
- Whether the patient had an ostomy performed.
- Whether the patient had anemia or secondary anemia.
- Whether the patient had dementia.
- Whether the patient was obese.
- Whether the patient had a smoking or nicotine dependence.
- Whether the patient was previously ventilator dependent.
- Whether the patient had a partial or total laparoscopic colectomy.
- Whether the patient had a recent percutaneous coronary intervention (PCI) or myocardial infarction (MI).
- Whether the patient had a concurrent major abdominal surgery or a recent major abdominal surgery (non-bowel).
- Whether the patient had antiplatelet or anticoagulant use or received a blood transfusion during a hospitalization.
- Whether the patient had cardiomyopathy, valve disease, or recent cardiac arrest.
- Whether the patient had home oxygen or recently received HH services.
- Whether the patient had portal hypertension or pulmonary hypertension.
- Whether the patient had metastatic disease.
- Whether the patient had a recent all-cause admission in 30 days prior to trigger day or a recent all-cause admission in the 120 days prior to the trigger day.
- Whether the patient had an emergent colectomy or inflammatory bowel disease (IBD).
- Whether the patient had a recent admission to a SNF, IRF, or a LTCH.
- Whether the patient had a rectal prolapse.

As with the CMS-HCC model, the risk adjustment approach for this measure uses an ordinary least squares linear regression model. 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 2 Colon and Rectal Resection measure sub-groups, which are based on the type of procedure, below:

- Colon Resection
- Rectal Resection

Full details of the risk adjustment model are in the draft Measure Codes List File available on the MACRA Feedback Page.[44]

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 International Classification of Diseases [ICD]-9 to ICD-10 codes) and is exhaustive on these code sets. Because the CMS-HCC model has already been extensively tested, we focus our testing on how the CMS-HCC model was adapted to the Colon and Rectal Resection 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. The Rectal Resection sub-group includes episodes that: (i) are triggered by a rectal procedure code, (ii) have a resection procedure trigger code that is accompanied by a rectal or anal cancer diagnosis code, or (iii) are triggered by a lower anterior resection (LAR) (i.e., CPT/HCPCS codes 44145, 44146, 44207, and 44208) when accompanied by an ICD-10 rectal cancer diagnosis code (i.e., C20). However, rectopexies (i.e., CPT/HCPCS code 45400, and 45402) are classified into the Colon Resection sub-group to ensure that the rectal procedures captured in the Rectal Resection sub-group are of similar complexity and entail comparable risks within the patient cohort. The Colon Resection sub-group captures all other cases triggered by the trigger codes not included in the definition for the Rectal Resection sub-group.

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.[45,46,47]

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

[44]CMS, MACRA Feedback Page, https://www.cms.gov/Medicare/Quality-Payment-Program/Quality-Payment-Program/Give-Feedback.
[45]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.
[46]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.
[47]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/.

organizations, or ACOs, previous physician Quality and Resource Use Reports, or QRUR programs, and other measures such as 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 measure). 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[48] and the Report to Congress: Risk Adjustment in Medicare Advantage.[49] 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 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 2.00% of episodes.

The percentage of female patients range from 52.49% to 60.36% across the 2 sub-groups in this measure. The majority of the patients (81.84% - 85.05%) 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 1.83% to 2.08% 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, 16.99% to 18.36% 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.

[48]Pope, Gregory C., John Kautter, et al., “Evaluation of the CMS-HCC Risk-Adjustment Model: Final Report.” RTI International: March 2011.
[49]CMS, “Report to Congress: Risk Adjustment in Medicare Advantage,” https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Downloads/RTC-Dec2018.pdf.

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 may be 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 lower expected spending in the Colon Resection sub-group, but higher expected spending in the Rectal Resection sub-group. There were also differences in the significance levels across the social risk factors. Using the same example, the regression coefficient for Asian patients is statistically significant at the 0.05 threshold for the Rectal Resection sub-group, but the coefficient for Asian patients is not statistically significant for the Colon Resection sub-group.

Second, we analyzed the impact of adding social risk variables on overall model performance by looking at the differences in the O/E ratio with and without social factors in the risk adjustment model. When including social risk factors in our risk adjustment regression, the minor differences in the O/E ratios, even for clinicians at high or low extremes of risk, indicates that social risk factor effects on the model performance are likely captured through existing risk adjustment variables. When including the social risk factors in risk adjustment, the measure scores for 94.00% of TINs and 93.71% 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 level, with a Spearman correlation coefficient of 0.99, and the TIN-NPI level, with a correlation coefficient of 0.99.These results indicate that the inclusion of social risk factors in the current risk adjustment model would have a limited effect on measure scores.

Due to the inconsistent direction and limited impact of social risk factor effects under the current risk adjustment model, we believe the Colon and Rectal Resection measure risk adjustment model sufficiently accounts for the effects of social risk factor on clinician measure scores.

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. The results should be evaluated in the context of the measure's service assignment rules, which are intended to ensure only clinically associated services are grouped to the 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.

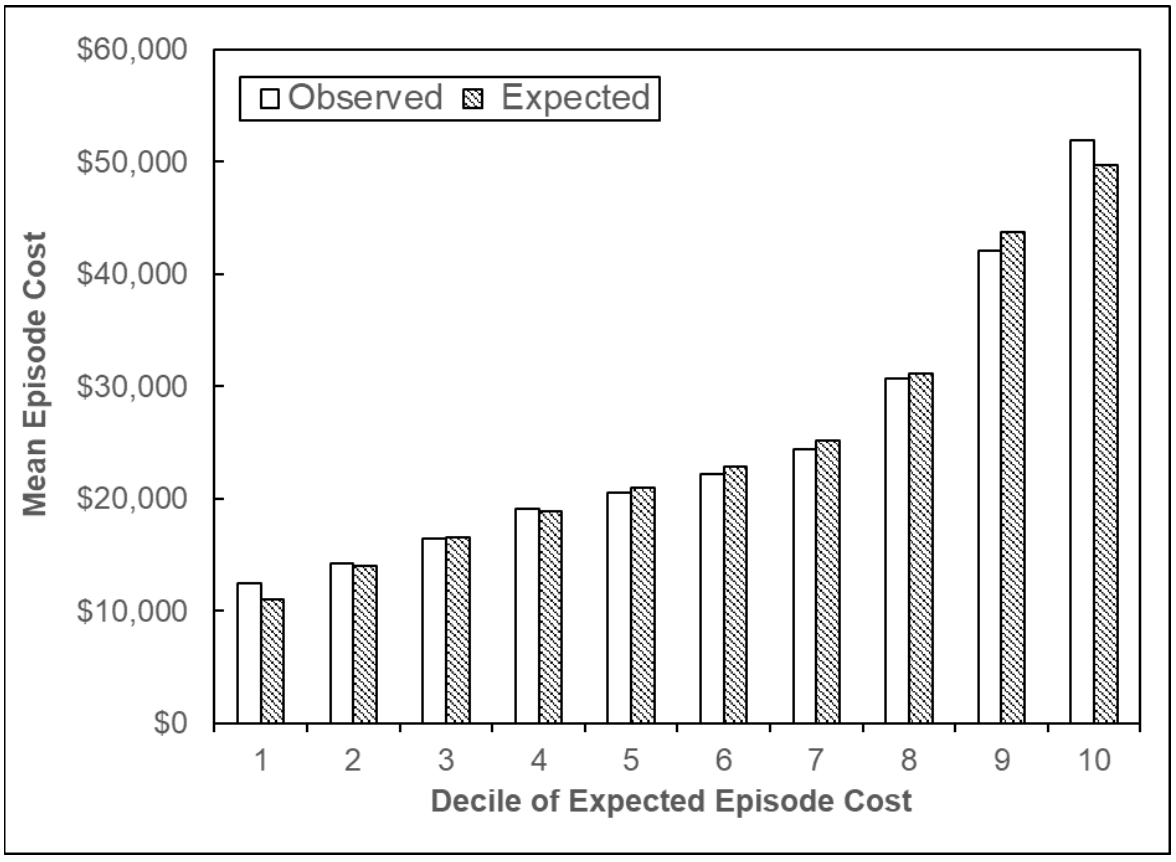
3.4.7 Statistical Risk Model Discrimination Statistics

The overall R-squared for the Colon and Rectal Resection cost measure, calculated by dividing explained sum of squares by total sum of squares is 0.48. The adjusted R-squared is 0.48. More information on discrimination testing for the CMS-HCC model can be found at Pope et al. 2011.[50]

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. With the exception of the first risk decile, where the risk adjustment model may be under predicting actual episode costs as observed by an O/E ratio greater than 1.0, the average O/E cost ratios are generally close to one. This indicates that the risk adjustment model is generally predicting actual episode costs accurately across most risk deciles, and additional refinements to the risk adjustment model may focus on potential ways to mitigate instances of under or over prediction. 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



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

3.4.9 Statistical Risk Model Calibration – Risk Decile

Analysis of predictive ratios by risk decile for the measure shows that the model generally has consistent predictive ratios across risk score deciles. With the exception of the first risk decile at 0.88, where the risk adjustment model is under predicting expected episode costs, the rest of the risk deciles have a predictive ratio between 0.99 and 1.04.

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.[51] 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 and 3.4.9, the average O/E cost ratios and the predictive ratios for most of the risk deciles are generally close to one. Predictive ratios close to one indicate that expected spending is accurately predicting observed spending. Overall, the results show that the model is accurately predicting observed spending, for most risk levels. Results also show that the risk adjustment model may be under predicting expected episode spending for the first risk decile, and additional refinements to the model may aim to mitigate this trend.

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 notable performance difference among clinicians in the Colon and Rectal Resection measure:

(i) The 99th percentile of the measure O/E cost ratio is more than 1.5 times the measure O/E cost ratio at the 1st percentile for both the TIN and TIN-NPI levels.

[51]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.

(ii) The Colon and Rectal Resection measure O/E cost ratio at the 90th percentile is approximately 24.18% greater than the O/E cost ratio at the 10th percentile at the TIN level and 28.09% greater at the TIN-NPI level.

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

The results also show that there is a limited systemic regional difference in clinician score. For instance, the mean O/E cost ratios for clinicians across 9 census divisions (excluding 'Unknown') are within a 0.05 or less range (i.e., 1.00 to 1.03 at the TIN level and 0.99 to 1.03 at the TIN-NPI level). Similarly, clinicians in urban areas seem to perform comparably to those in rural areas.

In terms of other clinician characteristics, analysis of clinicians by number of episodes indicates that clinicians with more episodes perform similarly to those who perform fewer procedures. 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 also show little variation by risk score decile, with a range in mean TIN O/E cost ratio of 1.01 to 1.03 and a range in mean TIN-NPI O/E cost ratio of 1.00 to 1.03, indicating that the risk adjustment model is overall functioning as intended.

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 cost measure O/E cost ratios are presented at the TIN level and the TIN-NPI level.

Table 5-A: Colon and Rectal Resection TIN Level Cost Measure O/E Ratios

Characteristic	# of TINs	Mean O/E Ratio	O/E Ratio Percentile						
			1st	10th	25th	50th	75th	90th	99th
All TINs	1,422	1.02	0.83	0.91	0.95	1.00	1.06	1.13	1.36
Sub-group									
Colon Resection	1,190	1.01	0.57	0.77	0.85	0.96	1.11	1.31	2.09
Rectal Resection	1,422	1.02	0.83	0.91	0.95	1.00	1.07	1.14	1.33
Urban/Rural									
Urban	1,216	1.02	0.84	0.92	0.96	1.01	1.06	1.14	1.35
Rural	200	1.00	0.80	0.88	0.93	1.00	1.06	1.12	1.41
Unknown	2	1.07	1.05	1.05	1.05	1.07	1.10	1.10	1.10
Census Region									
Northeast	245	1.02	0.84	0.92	0.96	1.02	1.07	1.14	1.28
Midwest	341	1.01	0.82	0.90	0.95	1.00	1.06	1.12	1.36
South	575	1.01	0.83	0.91	0.95	1.00	1.06	1.13	1.37
West	253	1.03	0.83	0.92	0.96	1.01	1.07	1.16	1.44
Unknown	8	1.00	0.94	0.94	0.95	0.97	1.06	1.10	1.10
Census Division									
New England	72	1.01	0.85	0.91	0.96	1.00	1.05	1.12	1.26
Middle Atlantic	173	1.03	0.84	0.93	0.97	1.03	1.08	1.16	1.28
East North Central	230	1.01	0.82	0.90	0.95	1.00	1.07	1.12	1.37
West North Central	111	1.00	0.83	0.91	0.94	0.99	1.04	1.11	1.22
South Atlantic	301	1.01	0.83	0.91	0.96	1.01	1.07	1.13	1.23
East South Central	108	1.01	0.84	0.91	0.94	0.99	1.06	1.12	1.46
West South Central	166	1.01	0.81	0.90	0.95	1.00	1.06	1.14	1.39
Mountain	99	1.03	0.82	0.92	0.96	1.02	1.07	1.17	1.52
Pacific	154	1.03	0.83	0.92	0.96	1.01	1.07	1.16	1.42
Unknown	8	1.00	0.94	0.94	0.95	0.97	1.06	1.10	1.10
Provider risk score decile									
1st	142	1.02	0.86	0.91	0.95	1.01	1.07	1.13	1.28
2nd	142	1.03	0.83	0.93	0.97	1.02	1.08	1.14	1.30
3rd	142	1.02	0.83	0.91	0.96	1.00	1.06	1.14	1.35
4th	143	1.01	0.82	0.92	0.96	1.00	1.05	1.12	1.22
5th	142	1.02	0.80	0.90	0.95	1.01	1.05	1.14	1.46
6th	142	1.01	0.84	0.93	0.96	1.00	1.05	1.11	1.37
7th	143	1.01	0.82	0.90	0.93	0.98	1.06	1.16	1.45
8th	142	1.02	0.82	0.92	0.96	1.02	1.06	1.12	1.23
9th	142	1.01	0.86	0.89	0.95	1.00	1.06	1.14	1.23
10th	142	1.02	0.83	0.89	0.95	1.02	1.08	1.14	1.32
Number of episodes									
10-19 Episodes	634	1.02	0.82	0.89	0.95	1.01	1.09	1.18	1.42
20-39 Episodes	415	1.01	0.84	0.91	0.95	1.00	1.07	1.13	1.22
40-59 Episodes	162	1.01	0.89	0.93	0.96	0.99	1.05	1.09	1.21
60-79 Episodes	78	1.01	0.89	0.94	0.97	1.01	1.04	1.07	1.35
80-99 Episodes	59	1.01	0.93	0.94	0.98	1.00	1.04	1.06	1.12
100-199 Episodes	65	1.00	0.92	0.96	0.98	1.00	1.03	1.05	1.12
200-299 Episodes	8	1.01	0.96	0.96	1.00	1.02	1.03	1.04	1.04
300+ Episodes	1	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

Table 5-B: Colon and Rectal Resection 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	1,993	1.01	0.81	0.89	0.94	0.99	1.06	1.14	1.37
Sub-group									
Colon Resection	1,658	1.02	0.60	0.76	0.84	0.96	1.11	1.33	2.24
Rectal Resection	1,993	1.01	0.80	0.89	0.93	0.99	1.07	1.14	1.38
Urban/Rural									
Urban	1,787	1.01	0.82	0.89	0.94	1.00	1.06	1.14	1.37
Rural	168	0.99	0.77	0.84	0.92	0.98	1.04	1.11	1.35
Unknown	3	1.08	0.99	0.99	0.99	1.12	1.14	1.14	1.14
Census Region									
Northeast	325	1.01	0.84	0.91	0.95	1.00	1.06	1.13	1.32
Midwest	455	1.00	0.79	0.88	0.93	0.98	1.04	1.11	1.34
South	844	1.01	0.80	0.89	0.93	1.00	1.06	1.14	1.39
West	328	1.03	0.84	0.90	0.95	1.01	1.07	1.16	1.43
Unknown	41	1.02	0.80	0.92	0.96	1.00	1.07	1.12	1.34
Census Division									
New England	98	0.99	0.77	0.90	0.94	0.99	1.04	1.10	1.26
Middle Atlantic	227	1.02	0.84	0.91	0.95	1.01	1.07	1.14	1.32
East North Central	278	1.00	0.79	0.87	0.92	0.98	1.06	1.14	1.37
West North Central	177	1.00	0.81	0.91	0.94	0.99	1.04	1.10	1.25
South Atlantic	464	1.01	0.80	0.89	0.94	1.00	1.07	1.14	1.37
East South Central	150	1.01	0.82	0.89	0.93	0.99	1.05	1.13	1.50
West South Central	230	1.00	0.80	0.88	0.92	0.98	1.06	1.12	1.37
Mountain	113	1.03	0.83	0.90	0.96	1.01	1.09	1.17	1.56
Pacific	215	1.02	0.86	0.91	0.95	0.99	1.07	1.16	1.41
Unknown	41	1.02	0.80	0.92	0.96	1.00	1.07	1.12	1.34
Provider risk score decile									
1st	199	1.03	0.86	0.91	0.95	1.00	1.08	1.17	1.43
2nd	199	1.01	0.81	0.89	0.94	1.00	1.06	1.11	1.36
3rd	200	1.01	0.82	0.90	0.95	0.99	1.06	1.12	1.35
4th	199	1.01	0.80	0.91	0.95	1.00	1.06	1.11	1.41
5th	199	1.00	0.80	0.89	0.94	0.99	1.06	1.13	1.40
6th	200	1.01	0.78	0.89	0.94	0.99	1.06	1.17	1.31
7th	199	1.01	0.80	0.89	0.93	0.99	1.07	1.15	1.35
8th	200	1.01	0.84	0.90	0.93	1.00	1.06	1.15	1.45
9th	199	1.00	0.81	0.88	0.94	0.99	1.05	1.12	1.34
10th	199	1.00	0.78	0.86	0.93	1.00	1.06	1.16	1.38
Number of episodes									
10-19 Episodes	1,448	1.01	0.80	0.88	0.93	0.99	1.07	1.15	1.40
20-39 Episodes	491	1.01	0.86	0.91	0.95	1.00	1.06	1.11	1.24
40-59 Episodes	49	1.00	0.89	0.92	0.96	0.99	1.02	1.09	1.13
60-79 Episodes	3	1.03	1.01	1.01	1.01	1.02	1.05	1.05	1.05
80-99 Episodes	2	1.05	1.03	1.03	1.03	1.05	1.06	1.06	1.06
100-199 Episodes	0	-	-	-	-	-	-	-	-
200-299 Episodes	0	-	-	-	-	-	-	-	-
300+ Episodes	0	-	-	-	-	-	-	-	-

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, the urban/rural divide, census regions,

census divisions, provider risk score decile, or episode volume at both the TIN and TIN-NPI levels. For each variable, the largest difference in the mean O/E cost ratio within each category was 0.04 or less. 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 variables. For sub-groups, the model is run separately for each sub-group to account for a more fair comparison across episodes in the Colon Resection sub-group and Rectal Resection sub-group. These results support that there is meaningful variation in cost performance, even after risk adjustment, across these variables. These results also indicate that there is a meaningful potential for Medicare savings and that there are no systemic differences across geographic region, level of provider risk, and case volume.

3.6 Missing Data Analysis and Minimizing Bias

3.6.1 Method

Since CMS uses Medicare claims data to calculate the Colon and Rectal Resection 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 patient date of birth information (an input to the risk adjustment model) cannot be found in the EDB, the patient does not appear in the EDB, or the patient death date occurs before the episode trigger date.

The Colon and Rectal Resection measure 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. Additionally, the Colon and Rectal Resection measure excludes episodes that cannot be attributed to a main surgeon.

3.6.2 Missing Data Analysis

The table below presents the frequency of missing data across the 5 categories of missing data which caused episodes to be excluded from the Colon and Rectal Resection 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 date of birth is missing.
- Patient death date occurred before the trigger date.
- 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.
- The episode cannot be attributed to a main surgeon.

Table 6: Missing Data Categories for the Colon and Rectal Resection Measure

Exclusion	# Episodes	# TINs	# TIN-NPIs
Missing birth date*	*	*	*
Death before trigger	96	91	113
Other primary payer	7,240	2,275	5,917
Not continuously enrolled	4,543	1,905	4,208
No main surgeon	480	349	424

* This indicates that there were fewer than 11 episodes.

3.6.3 Interpretation

As the Colon and Rectal Resection measure is calculated with Medicare claims data, Acumen expects a high degree of data completeness, which is supported by the limited frequency 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 Colon and Rectal Resection Clinician Expert Workgroup is composed from the larger General and Colorectal Surgery Clinical Subcommittee. The composition list of the Clinical Subcommittee is included in the Episode-Based Cost Measures Development Process document.[52]

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