

Quality Payment PROGRAM

Prostate Cancer

Measure Testing Form

January 2023



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1.0 Introduction

This Measure Testing Form (MTF) provides a brief summary of the preliminary measure testing results as part of field testing five episode-based cost measures. Readers may review these results, alongside other documentation, to provide feedback on the draft measure using the [field testing survey](#). The testing results reflect the performance of the measure as specified at the time of field testing, which is part of the measure development process. Please see the Draft Cost Measure Methodology for a description of the measure specifications and the Draft Measure Codes List for the list of codes used to specify the measure.¹

1.1 Project Title and Overview

The Centers for Medicare & Medicaid Services (CMS) has contracted with Acumen, LLC to develop care episode and patient condition groups for use in cost measures to meet the requirements of the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA). The contract name is “Physician Cost Measures and Patient Relationship Codes (PCMP).” The contract number is 75FCMC18D0015, Task Order 75FCMC19F0004.

1.2 Measure Name

Prostate Cancer Episode-Based Cost Measure

1.3 Type of Measure

Cost/Resource Use

1.4 Data

The study period is January 1, 2021 through December 31, 2021. All episodes ending during the study period that meet inclusion and exclusion criteria are included in testing. The measure is calculated with Medicare Parts A, B, and D administrative claims data, Long-Term Minimum Data Set, Medicare Enrollment Database. For testing purpose, other data sources are used, including the American Community Survey and Common Medicare Environment.

Testing results are presented at a testing volume threshold of 20 episodes for clinician groups and individual clinicians. Clinician groups are identified by a Tax Identification Number (TIN). Individual clinicians are identified using a combination of a Tax Identification Number and National Provider Identifier (TIN-NPI).

¹ These documents 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 Preliminary Testing Results

This section presents preliminary testing results based on the measure as specified for field testing. Section 2.1 provides an overview of the measure's coverage of beneficiaries and cost. Section 2.2 lists the most frequently attributed specialties. Sections 2.3 through 2.5 provide evidence of scientific acceptability of the measure. Section 2.6 presents empirical results of the risk adjustment and stratification methods used by this measure. Section 2.7 examines the impact of adding social risk factors to the measure's risk adjustment model. Lastly, Section 2.8 examines the impact of exclusion criteria used by the measure through their frequency and resource use patterns.

2.1 Measure Coverage

This measure has the potential to have high impact as prostate cancer is a common condition for the Medicare population, as shown in the results below. Table 1 shows the number of patients and the proportions of Medicare Parts A and B cost covered by this measure.

Table 1: Measure Coverage

Metric	Value
Number of Beneficiaries	455,101
Mean Age	75.53
Male %	99.9%
Percent of Parts A & B Costs Covered by the Measure – TIN	0.77%
Percent of Parts A & B Costs Covered by the Measure – TIN-NPI	0.40%

Table 2 shows the characteristics of TINs and TIN-NPIs who are attributed at least 20 episodes. This measure has the potential to have high impact as prostate cancer is a common condition for the Medicare population, as shown in the results below.

Table 2: Clinician Characteristics

Metric	TIN		TIN-NPI	
	Count	%	Count	%
Count	3,576	100%	5,630	100%
Number of Episodes Attributed	-	-	-	-
20-39 Episodes	1,194	33.4%	2,886	51.3%
40-59 Episodes	564	15.8%	1,294	23.0%
60-79 Episodes	366	10.2%	694	12.3%
80-99 Episodes	237	6.6%	354	6.3%
100-199 Episodes	568	15.9%	365	6.5%
200-299 Episodes	222	6.2%	29	0.5%
300+ Episodes	425	11.9%	8	0.1%
Census Region	-	-	-	-
Northeast	677	18.9%	1,014	18.0%
Midwest	685	19.2%	1,081	19.2%
South	1,427	39.9%	2,443	43.4%
West	773	21.6%	1,087	19.3%
Unknown	14	0.4%	5	0.1%

2.2 Frequently Attributed Specialties

Table 3 shows the top 10 attributed specialties for this measure, using a 20-episode testing volume threshold. The most frequently attributed specialties reflect the intent of the measure to capture costs of the management of prostate cancer, including both primary care clinicians and specialists. These clinicians are also consistent with input provided by stakeholders, including patient and family partners (PFPs), during the measure development process. PFPs identified urologists, oncologists, radiologists, primary care clinicians, and nurse practitioners, amongst others, as being part of their care team.

Table 3: Count of the Top 10 Attributed Specialties

Specialty	Number of TIN-NPIs Attributed
Urology	3,899
Radiation Oncology	401
Hematology/Oncology	356
Internal Medicine	319
Medical Oncology	199
Nurse Practitioner	176
Physician Assistant	139
Family Practice	96
Hematology	10
Cardiology	9

2.3 Reliability

Reliability evaluates a measure's ability to consistently differentiate the performance of one clinician from another. The signal-to-noise ratio is used to estimate reliability, which indicates how much of the variation in the measure score is explained by differences among clinicians' performance (i.e., signal) instead of differences within each clinician's performance (i.e., noise). Specifically, noise is the variation from one episode to another during the performance period for a particular clinician.

Table 4 shows reliability metrics at various testing volume thresholds. While higher thresholds yield higher reliability results, it is at the cost of further reducing the number of clinicians and clinician groups eligible for the measure, which would reduce the potential impact of the measure. For the purposes of field testing, we used a 20-episode volume threshold (bolded in the table below). If the measure is implemented in the Merit-based Incentive Payment System (MIPS) in the future, CMS will establish a case minimum through notice-and-comment rulemaking.

Table 4: Sample Size, Mean Reliability, and Proportion of Clinicians above Moderate Reliability at Various Testing Volume Thresholds

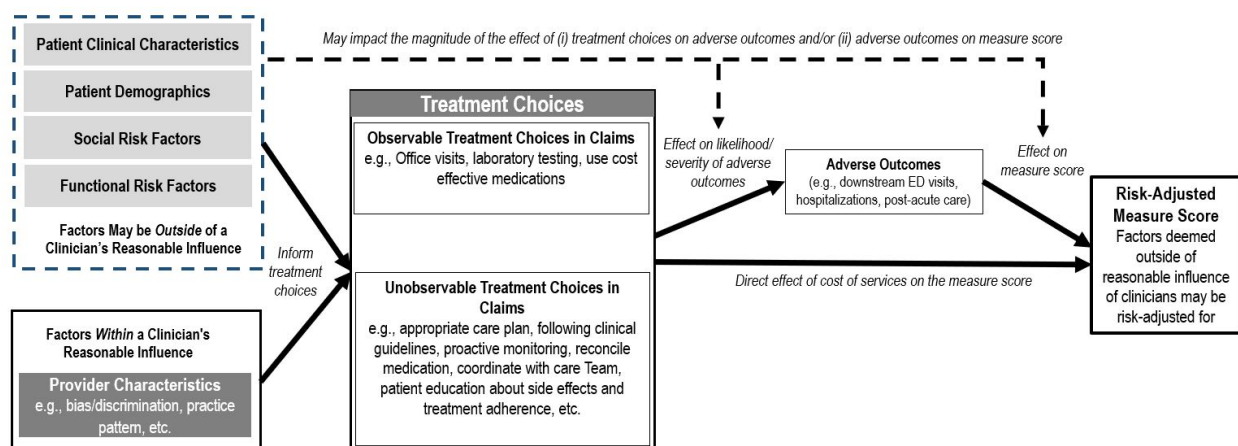
Testing Volume Threshold	TIN			TIN-NPI		
	Number of TINs	Mean Reliability	Percent Above 0.4	Number TIN-NPIs	Mean Reliability	Percent Above 0.4
10	5,567	0.69	85.4%	10,642	0.60	76.9%
20	3,576	0.76	95.0%	5,630	0.66	88.4%
30	2,824	0.80	98.6%	3,794	0.70	95.6%

At the testing volume of 20 episodes, the mean reliability for the Prostate Cancer measure is high, specifically 0.76 at the TIN level and 0.66 at the TIN-NPI level (Table 4). CMS generally considers 0.4 as the threshold indicating ‘moderate’ reliability and 0.7 indicating ‘high’ reliability, which is supported by previous work into reliability and the threshold was finalized in the 2022 Physician Fee Schedule final rule.^{2,3} A vast majority of TINs and TIN-NPIs meet or exceed the moderate reliability threshold of 0.4 at the 20-episode testing volume threshold.

2.4 Validity

Validity is a criterion that evaluates whether the cost measure is able to quantify the construct that it aims to measure, which is the cost directly related to treatment choices and cost of adverse outcomes as a result of care. Validity is evaluated empirically by estimating the effect of relevant treatment choices on the measure score using multiple regression, based on the conceptual model outlined in Figure 1.

Figure 1: Conceptual Model of the Relationship between Treatment Choices and the Measure Score



² Mathematica, Inc., “Memorandum: Reporting Period and Reliability of AHRQ, CMS 30-Day and HAC Quality Measures – Revised,” http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/hospital-value-based-purchasing/Downloads/HVBP_Measure_Reliability-.pdf.

³ CMS, “Medicare Program; CY 2022 Payment Policies Under the Physician Fee Schedule and Other Changes to Part B Payment Policies; Medicare Shared Savings Program Requirements; Provider Enrollment Regulation Updates; and Provider and Supplier Prepayment and Post-Payment Medical Review Requirements,” [86 FR 64996-66031](https://www.federalregister.gov/documents/2021/08/16/2021-16496).

The cost measure is designed to reflect the cost directly related to treatment choices, as well as the cost of adverse outcomes as a result of care. Therefore, treatment choices, either observable in claims or otherwise, by an attributed clinician can directly impact the measure score or indirectly when they're mediated through the cost of adverse outcomes. The cost of adverse outcomes, in turn, contributes to the total costs that are captured by the measure score.

To demonstrate that the measure score is reflective of both the direct and indirect effects of treatment choices, this analysis first estimates the association between treatment choices and the measure score while controlling for the cost of adverse outcomes. Then, the association between treatment choices and the cost of adverse outcomes is estimated to demonstrate the indirect effect.

Generally, adverse outcomes are non-trigger inpatient hospitalizations, non-trigger emergency room visits, and post-acute care. The remaining service categories are generally considered treatment. For each of these categories, the regression models use the mean cost across episodes that were attributed to an individual clinician. The measure score is represented by a clinician's mean observed cost over expected cost ratio across their attributed episodes.

Overall, the results demonstrate that the cost measure is reflective of both the cost directly related to treatment choices, as well as cost of adverse outcomes as a result of care (Table 5). Therefore, there's evidence that the measure is capturing what it purports to measure.

Model 1 shows that outpatient evaluation and management services are associated with better measure score at the TIN-NPI reporting level, and outpatient therapies are associated with a better measure score at both reporting levels. Part B medications have either very small or no association with measure score or cost of adverse events. However, part D medications appear to be associated with a worse measure score. While the magnitude of the association appears small, it is scaled based on each additional thousand dollars spent, so the net impact on the score may be larger if the total spending on medication is also large.

Major or minor procedures, anesthesia services, laboratory testing, durable equipment are associated with a worse measure score. However, model 2 shows that major procedures are associated with lowered cost of adverse outcomes, but they may be prone to over-use based on results of model 1. In model 2, except for major procedures, all services are associated with higher cost of adverse outcomes, which may be reflective of higher clinical needs or complexities of patients.

Table 5: Estimated Effect of Treatment Choices

Categories of Service	Coefficient in Thousands [95% Confidence Interval] (p-value)			
	TIN		TIN-NPI	
	Model 1: Mean O/E = Mean Cost of Treatment Choices + Mean Cost of Adverse Events	Model 2: Mean Cost of Adverse Events = Mean Cost of Treatment Choices	Model 1: Mean O/E = Mean Cost of Treatment Choices + Mean Cost of Adverse Events	Model 2: Mean Cost of Adverse Events = Mean Cost of Treatment Choices
Adverse Events	0.07 [0.06,0.08] (p < 0.01)	-	0.09 [0.08,0.10] (p < 0.01)	-
Outpatient Evaluation & Management Services	0.04 [-0.01,0.09] (p = 0.10)	0.80 [0.67,0.94] (p < 0.01)	-0.07 [-0.12,-0.02] (p < 0.01)	0.94 [0.82,1.06] (p < 0.01)
Major Procedures	0.08 [0.07,0.08] (p < 0.01)	-0.05 [-0.07,-0.04] (p < 0.01)	0.11 [0.10,0.11] (p < 0.01)	-0.05 [-0.06,-0.04] (p < 0.01)
Ambulatory/Minor Procedures	0.19 [0.14,0.23] (p < 0.01)	0.21 [0.08,0.34] (p < 0.01)	0.18 [0.14,0.22] (p < 0.01)	0.22 [0.13,0.31] (p < 0.01)
Anesthesia Services	2.90 [2.36,3.44] (p < 0.01)	4.95 [3.45,6.45] (p < 0.01)	2.31 [1.90,2.71] (p < 0.01)	4.21 [3.20,5.22] (p < 0.01)
Outpatient Physical, Occupational, or Speech and Language Pathology Therapy	-0.77 [-1.19,-0.34] (p < 0.01)	5.25 [4.06,6.43] (p < 0.01)	-0.49 [-0.87,-0.12] (p = 0.01)	0.18 [-0.76,1.12] (p = 0.71)
Laboratory, Pathology, and Other Tests	0.17 [0.12,0.22] (p < 0.01)	0.18 [0.03,0.33] (p = 0.02)	0.13 [0.09,0.18] (p < 0.01)	0.05 [-0.07,0.16] (p = 0.41)
Durable Medical Equipment and Supplies	0.28 [0.17,0.39] (p < 0.01)	0.16 [-0.15,0.47] (p = 0.31)	0.24 [0.16,0.31] (p < 0.01)	0.26 [0.07,0.45] (p < 0.01)
Chemotherapy and Other Part B- Covered Drugs	-0.01 [-0.01,0.00] (p < 0.01)	0.01 [0.00,0.02] (p = 0.06)	0.00 [0.00,0.00] (p = 0.89)	0.02 [0.01,0.03] (p < 0.01)
Part-D Drugs	0.01 [0.01,0.02] (p < 0.01)	0.02 [0.01,0.03] (p < 0.01)	0.01 [0.01,0.02] (p < 0.01)	0.01 [0.00,0.01] (p = 0.13)

2.5 Performance Gap

Table 6 shows the distribution of the measure score for clinicians and clinician groups. These results align with expectations based on our review of the literature and demonstrate that there

is a performance gap in cost measure performance at both the clinician and clinician group levels. The Prostate Cancer cost measure score at the 90th percentile is over 2 times greater than the measure score at the 10th percentile at both the TIN and TIN-NPI levels. The variation in the measure score, indicated by the interquartile range and standard deviation, is in the thousands of dollars. The results suggest that there is opportunity for improvement in performance across clinicians.

Table 6: Distribution of the Measure Score

Metric	TIN	TIN-NPI
Mean Score	\$10,451	\$10,183
Score Interquartile Range (IQR)	\$4,338	\$5,199
Standard Deviation	\$3,686	\$4,250
Coefficient of Variation	0.35	0.42
Score Percentile		
10 th	\$6,129	\$5,375
25 th	\$8,018	\$7,165
50 th	\$10,090	\$9,620
75 th	\$12,356	\$12,365
90 th	\$14,985	\$15,747

2.6 Risk Adjustment and Stratification

Figure 1 shows the conceptual model that outlines how patient-level and clinician-level factors can influence the measure score, which is informed by both published external research and our own data analysis.^{4,5,6,7} The conceptual model includes risk factors that are either known by the literature or informed by the Clinical Expert Workgroup to be within or outside of the influence of the attributed clinician. Risk factors, including social risk factors (SRFs), can both influence the treatment choices and impact the size of the effect of treatment choices by mitigating the risk of adverse outcomes and the cost of adverse outcomes.

A systematic approach then guides the decision of which factors to include in the risk adjustment model. First, we reviewed the literature to gather known risk factors and drivers of resource use. These factors are usually diagnoses; therefore, the first set of risk adjusters are commonly the Hierarchical Condition Categories. Then, we consulted our clinical expert panels on additional factors that are known to be associated with resource use. Together with our clinical expert panel, we reviewed the stratified results on episode cost across many different patient characteristics. We arrived at the final list of risk adjusters based on those discussions and consensus among the clinical experts. Additionally, during our testing phases, we also

⁴Assistant 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.

⁵Chen 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

⁶Medicare 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/>.

⁷Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health & Human Services. Second Report to Congress on Social Risk Factors and Performance in Medicare's Value-Based Purchasing Program. 2020. <https://aspe.hhs.gov/social-risk-factors-and-medicare-value-based-purchasing-programs>

follow a structured and systematic approach to decide whether SRFs should be risk-adjusted for, which is further described in Section 2.7.

2.6.1 Discrimination

Discrimination is a statistical criterion that evaluates the measure's ability to distinguish high-cost episodes from low-cost episodes, or the ability to explain the variance in cost of individual episodes. The amount of variance explained is estimated by the R-squared metric with the range between 0 and 1. The R-square value for the measure is 0.34, and 0.34 after adjusting for the model's complexity based on the number of risk adjustors used. In other words, 34% of the variation in the actual observed cost of episodes is explained by the risk adjustment model and sub-group stratification.

The remaining unexplained variance is due to variation in factors that are not adjusted for by the measure, such as the clinician's performance. The objective of a cost measure is to evaluate and differentiate the performance of clinicians. Therefore, achieving high explained variance is not essential because not all of the variation in cost of care should be adjusted. In collaboration with the experts from our clinical workgroup, this measure only adjusts for factors that are deemed to be outside of the influence of clinicians. Please see the Draft Cost Measure Methodology for more information on the full list of risk adjustors and sub-groups.

2.6.2 Calibration

Calibration evaluates the consistency of the measure in estimating episode cost across the full range of resource use patterns in the population. Calibration is estimated by the average predictive ratios across groups within the population, specifically groups are partitioned by deciles of expected episode cost. The predictive ratio is calculated using the formula of average expected cost / average observed cost for all episodes in each decile. A well-calibrated measure should have predictive ratios close to 1.00 across all deciles. In other words, such results show that the measure is consistent because it does not under- or over-predict cost throughout the range of resource use patterns in the population.

Table 7 shows there is some under-prediction for the low-risk episodes and over-prediction for the high-risk episodes. The results suggest opportunities to improve the risk classification by refining the risk adjustors and further examining drivers of costs.

Table 7: Predictive Ratio by Decile of Predicted Episode Cost

Decile	Average Predictive Ratio
Decile 1	0.69
Decile 2	0.78
Decile 3	0.84
Decile 4	0.90
Decile 5	0.89
Decile 6	0.88
Decile 7	0.86
Decile 8	0.88
Decile 9	0.99

Decile	Average Predictive Ratio
Decile 10	1.23

2.7 Social Risk Factor Analysis

Beyond clinical characteristics of patients, the cost of care may be influenced by non-clinical factors related to a patient's social risk factors (SRFs), such as race, income, education, and employment. At the program level, MIPS adjusts for SRFs using the MIPS Complex Patient Bonus to ensure clinicians or groups treating more complex patients are not disadvantaged.⁸ At the measure-level, the testing helps to navigate the tension between ensuring fairness for clinicians treating higher shares of vulnerable patients and the possibility of masking poor performance and perpetuating disparity if clinicians are held to different standards.

Table 8 outlines variables that may indicate SRFs and their advantages and disadvantages as indicators of individual-level SRFs. Based on availability of data, this analysis tested all variables except for the ICD-10 Z codes.

Table 8: Social Risk Factors Available for Analysis

Variable	Advantages	Disadvantages	Used in Testing
Dual Medicare and Medicaid enrollment status	<ul style="list-style-type: none"> Available for all beneficiaries Most powerful predictor of poor outcomes⁹ 	<ul style="list-style-type: none"> Variation in Medicaid eligibility across states 	Yes
Race/Ethnicity	<ul style="list-style-type: none"> Available for most beneficiaries, except for ambiguous categories of "Unknown" or "Other" 	<ul style="list-style-type: none"> Social risk driven by someone's race is often correlated with and partially captured by dual status¹⁰ Only 5 categories available, which may lack granularity to fully capture disparities^{11,12} 	Yes

⁸ <https://qpp-cm-prod-content.s3.amazonaws.com/uploads/966/QPP%20COVID-19%20Response%20Fact%20Sheet.pdf>

⁹ Refer to footnote 4.

¹⁰ Refer to footnote 4.

¹¹ Nguyen, Kevin H., Kaitlyn P. Lew, and Amal N. Trivedi. "Trends in Collection of Disaggregated Asian American, Native Hawaiian, and Pacific Islander Data: Opportunities in Federal Health Surveys." *American Journal of Public Health* (2022).

¹² Kader, Farah, Lan N. Doan, Matthew Lee, Matthew K. Chin, Simona C. Kwon, and Stella S. Yi. "Disaggregating Race/Ethnicity Data Categories: Criticisms, Dangers, And Opposing Viewpoints", *Health Affairs Forefront* (2022).

Variable	Advantages	Disadvantages	Used in Testing
ICD-10 Z codes for social determinants of health	<ul style="list-style-type: none"> Reflects individual-level factors that influence health status and contact with health services 	<ul style="list-style-type: none"> Not routinely and consistently coded on claims, only available for 0.1% of all fee-for-service claims in 2019¹³ 	No
American Community Survey	<ul style="list-style-type: none"> Can link beneficiary's ZIP code to socioeconomic (SES) measurement of their neighborhood Many SES indices can be derived from the survey data (e.g., Agency for Healthcare Research and Quality SES index, deprivation index) 	<ul style="list-style-type: none"> Only a proxy measure, not always accurate at individual-level 	Yes

First, this analysis evaluated each of the variables for their association with episode cost using step-wise regression. Testing findings demonstrate that dual Medicare and Medicaid enrollment status is the most consistent predictor, even in the presence of other variables (Tables 9 and B1). This is also consistent with other research that found dual status to be the best proxy of SRFs in predicting health outcomes.¹⁴

Table 9: Associations of Available Social Risk Factor Variables and Cost of Care – TIN Reporting Level

Subgroup Risk Model	Variable	Coefficient in Log-transformed Episode Cost (Standard Deviation, P-value)		
		Model 1: Base Model + Dual Status	Model 2: Base Model + Dual Status + Race	Model 3: Base Model + Dual Status + Race + AHRQ SES
No recent metastatic cancer diagnosis, metastatic drugs with Part D	Dual Status	0.23 (SD: 0.01, p: <0.001)	0.23 (SD: 0.01, p: <0.001)	0.23 (SD: 0.01, p: <0.001)
	Race - Asian	-	-0.03 (SD: 0.02, p: 0.13)	-0.03 (SD: 0.02, p: 0.12)
	Race - Black	-	0.02 (SD: 0.01, p: 0.02)	0.02 (SD: 0.01, p: 0.01)

¹³ Centers for Medicare & Medicaid (CMS), Office of Minority Health. "Utilization of Z Codes for Social Determinants of Health among Medicare Fee-for-Service Beneficiaries." (2019) <https://www.cms.gov/files/document/z-codes-data-highlight.pdf>

¹⁴ Office of the Assistant Secretary for Planning and Evaluation. "Second report to Congress on social risk and Medicare's value-based purchasing programs." (2020) <https://aspe.hhs.gov/pdf-report/second-impact-report-to-congress>

Subgroup Risk Model	Variable	Coefficient in Log-transformed Episode Cost (Standard Deviation, P-value)		
		Model 1: Base Model + Dual Status	Model 2: Base Model + Dual Status + Race	Model 3: Base Model + Dual Status + Race + AHRQ SES
	Race - Hispanic	-	-0.07 (SD: 0.02, p: <0.001)	-0.06 (SD: 0.02, p: <0.001)
	Race - North American Native	-	0.29 (SD: 0.05, p: <0.001)	0.29 (SD: 0.05, p: <0.001)
	Race - Others	-	0.02 (SD: 0.01, p: 0.06)	0.02 (SD: 0.01, p: 0.08)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.04)
No recent metastatic cancer diagnosis, metastatic drugs without Part D	Dual Status	0.5 (SD: 0.09, p: <0.001)	0.5 (SD: 0.09, p: <0.001)	0.51 (SD: 0.09, p: <0.001)
	Race - Asian	-	0.02 (SD: 0.04, p: 0.66)	0.01 (SD: 0.04, p: 0.77)
	Race - Black	-	0 (SD: 0.01, p: 0.65)	0.01 (SD: 0.01, p: 0.52)
	Race - Hispanic	-	0.04 (SD: 0.05, p: 0.41)	0.05 (SD: 0.05, p: 0.34)
	Race - North American Native	-	0.14 (SD: 0.06, p: 0.01)	0.15 (SD: 0.06, p: 0.01)
	Race - Others	-	0.01 (SD: 0.02, p: 0.59)	0 (SD: 0.02, p: 0.83)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.02)
Recent metastatic cancer diagnosis, metastatic drugs with Part D	Dual Status	0.37 (SD: 0.02, p: <0.001)	0.33 (SD: 0.02, p: <0.001)	0.33 (SD: 0.02, p: <0.001)
	Race - Asian	-	0.09 (SD: 0.04, p: 0.03)	0.09 (SD: 0.04, p: 0.04)
	Race - Black	-	0.14 (SD: 0.02, p: <0.001)	0.14 (SD: 0.02, p: <0.001)
	Race - Hispanic	-	0.1 (SD: 0.05, p: 0.03)	0.1 (SD: 0.05, p: 0.05)
	Race - North American Native	-	0.43 (SD: 0.1, p: <0.001)	0.43 (SD: 0.1, p: <0.001)

Subgroup Risk Model	Variable	Coefficient in Log-transformed Episode Cost (Standard Deviation, P-value)		
		Model 1: Base Model + Dual Status	Model 2: Base Model + Dual Status + Race	Model 3: Base Model + Dual Status + Race + AHRQ SES
Recent metastatic cancer diagnosis, metastatic drugs with Part D	Race - Others	-	-0.05 (SD: 0.02, p: 0.04)	-0.05 (SD: 0.02, p: 0.06)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.5)
Recent metastatic cancer diagnosis, metastatic drugs without Part D	Dual Status	-0.17 (SD: 0.17, p: 0.31)	-0.18 (SD: 0.17, p: 0.3)	-0.17 (SD: 0.17, p: 0.3)
	Race - Asian	-	0.13 (SD: 0.09, p: 0.17)	0.09 (SD: 0.1, p: 0.38)
	Race - Black	-	-0.02 (SD: 0.03, p: 0.45)	-0.02 (SD: 0.03, p: 0.48)
	Race - Hispanic	-	-0.04 (SD: 0.12, p: 0.75)	-0.04 (SD: 0.12, p: 0.74)
	Race - North American Native	-	0.1 (SD: 0.13, p: 0.43)	0.1 (SD: 0.13, p: 0.43)
	Race - Others	-	0.03 (SD: 0.04, p: 0.53)	0.02 (SD: 0.04, p: 0.65)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.96)

The subsequent analyses focus on dual status as the main proxy variable for SRFs for risk adjustment. To determine whether it's appropriate to risk adjust for SRFs, the following criteria are considered:

- (i) whether there's an association between social risk and performance by examining the coefficient of patient-level dual status when added into the risk model,
- (ii) whether the observed association is most influenced by patient-level factors or clinician-level factors by examining the stability of the patient-level dual status coefficient after adding clinician's dual share variable, as well as including the clinician's fixed effects,
- (iii) whether the patient's need or complexity (rather than poor quality) is driving the observed performance differences by examining the differences in performance on dual patients versus non-dual patients and if there are many clinicians who are able to perform similarly or better on their dual patients than their non-dual patients, and
- (iv) the impact of risk adjusting for SRFs by examining the performance shift of clinicians compared to a risk adjustment model that doesn't risk adjust for SRFs.

There's a statistically significant association between the patient's dual status and episode cost, as observed on the largest subgroups (Table 10). This association is relatively stable in the largest subgroups and remains statistically significant after adding variables to account for clinician-level factors, which suggests that the patient-level factors are more influential than

clinician-level factors. Performance degradation is associated with higher share of dual beneficiaries and is degradation observed on both dual and non-dual episodes when stratified (Table 11). While many clinicians are able to perform equally well on their dual episodes and non-dual episodes, there are still a substantial number of clinicians performing significantly worse on their dual episodes than their non-dual episodes, which suggests that clinicians aren't able to fully mitigate the effect of SRFs (Table 12). Lastly, risk adjusting for dual status appears to change the performance ranking for a subset of clinicians (Table 13).

Table 10: Coefficient of Patient-level Dual Status under Different Models

Level	Subgroup Risk Model	% of All Episodes	Coefficient of Patient-level Dual Status in Log-transformed Episode Cost (P-value)		
			Base Model + Patient-level Dual Status	Base Model + Patient-level Dual Status + Clinician's Dual Share	Base Model + Patient-level Dual Status + Clinician's Fixed Effect
TIN	No recent metastatic cancer diagnosis, metastatic drugs with Part D	60.87%	0.23 (p<0.001)	0.16 (p<0.001)	0.16 (p<0.001)
	No recent metastatic cancer diagnosis, metastatic drugs without Part D	23.41%	0.5 (p<0.001)	0.44 (p<0.001)	0.44 (p<0.001)
	Recent metastatic cancer diagnosis, metastatic drugs with Part D	11.82%	0.37 (p<0.001)	0.33 (p<0.001)	0.34 (p<0.001)
	Recent metastatic cancer diagnosis, metastatic drugs without Part D	3.90%	-0.17 (p=0.31)	-0.26 (p=0.13)	-0.12 (p=0.55)
TIN_NPI	No recent metastatic cancer diagnosis, metastatic drugs with Part D	60.18%	0.23 (p<0.001)	0.15 (p<0.001)	0.15 (p<0.001)
	No recent metastatic cancer diagnosis, metastatic drugs without Part D	23.24%	0.46 (p<0.001)	0.38 (p<0.001)	0.40 (p<0.001)
	Recent metastatic cancer diagnosis, metastatic drugs with Part D	12.47%	0.39 (p<0.001)	0.33 (p<0.001)	0.33 (p<0.001)
	Recent metastatic cancer diagnosis, metastatic drugs without Part D	4.11%	-0.08 (p=0.71)	-0.19 (p=0.34)	-0.23 (p=0.44)

Table 11: Mean Ratio of Observed Cost to Expected Cost (O/E) Stratified by Clinician's Dual Share and Patient's Dual Status

Dual Share	TIN			TIN-NPI		
	All Episodes	Dual Episodes	Non-Dual Episodes	All Episodes	Dual Episodes	Non-Dual Episodes
All	1.10	1.25	1.09	1.13	1.21	1.13
0%	0.99	-	0.99	1.10	-	1.10
1-20%	1.12	1.24	1.11	1.14	1.20	1.13
21-40%	1.20	1.23	1.19	1.21	1.26	1.19
41-60%	1.28	1.36	1.18	1.27	1.22	1.30
61-80%	1.26	1.30	1.18	1.22	1.28	1.13
81-99%	1.82	1.81	1.73	2.04	1.90	2.58

Table 12: Proportions of Clinicians Who Perform Significantly Worse, Equally Well, or Significantly Better on Their Dual Episodes than Non-Dual Episodes

Reporting Level	Significantly Worse	Equally Well	Significantly Better
TIN	9%	91%	0%
TIN-NPI	9%	91%	0%

Table 13: Clinicians' Performance Shift Measured by the Change in the Average Ratio of Observed Cost to Expected Cost (O/E)

Reporting Level	Proportions of Clinicians Affected at Various Levels of Performance Shift	
	Ranking Shift by 1% or more	Ranking Shift by 5% or more
TIN	66.5%	6.1%
TIN-NPI	58.5%	4.2%

2.8 Impact of Exclusions

Table 14 displays descriptive statistics of all episodes meeting the measure's triggering logic, excluded episodes, and final reportable episodes at both TIN and TIN-NPI levels. These exclusion criteria ensure that the reportable episode populations are more homogenous and comparable than all episodes meeting triggering logic. It is worth noting that only the observed cost is shown, which has not been risk adjusted for using our risk adjustment model. Therefore, the differences in cost may appear much smaller after risk adjustment than as-is.

Overall, exclusion criteria decrease the distribution of observed cost of all episodes meeting trigger logic, from the mean of \$12,737 to \$9,511 at the TIN-level and \$8,480 at the TIN-NPI level (Table 14). All of the exclusion criteria have higher mean observed cost than all episodes meeting triggering logic. The largest exclusions come from removing episodes with no attributed clinician and applying the testing volume threshold to ensure a sufficient sample size for the measure.

Episodes shorter than one year are excluded because the methodology for the chronic measures requires at least one year of claims data to measure clinician cost performance to ensure sufficient

observation of chronic care, which is often intermittent and sparse over a long period of time. Although these episodes are excluded during the performance period being examined, they are likely to be included in the following performance period once the episode length is longer than one year.

Episodes where a beneficiary died before the episode end date are excluded because they do not provide sufficient data in the episode window period. These episodes also have a higher mean observed cost than all episodes meeting triggering logic, at \$44,207 (Table 14), likely because the costs are distributed over fewer days than a typical episode.

Episodes classified as outlier cases are excluded because they deviate substantially from the projected cost for a given patient risk profile. Outlier episodes have a mean observed episode cost of \$23,640 compared to \$12,737 for all episodes meeting triggering logic (Table 14). The wide variability of observed episode costs for outlier cases also supports their exclusion. At the 10th percentile the outlier cases observed cost is \$42 and at the 90th percentile the observed cost is \$46,642.

Episodes where there is not an attributed clinician are excluded because these episodes do not have any TIN-NPIs that billed at least 30% of the clinically-related claims with a relevant diagnosis. As such, they cannot be used in the measure at the TIN-NPI level.

Based on testing results and input from the clinical expert workgroup, hospice care patients are excluded because hospice use may be an indicator of terminal cases. These episodes have a higher resource use pattern than all episodes meeting trigger logic, with a mean observed episode cost of \$14,394 (Table 14).

Table 14: Cost Statistics for Measure Exclusions

Exclusion Criteria	Episodes		Observed Episode Cost					
	Count	Percent of All Episodes Meeting Trigger Logic	Mean	Percentile				
				10 th	25 th	50 th	75 th	90 th
All Episodes Meeting Triggering Logic	782,414	100.00%	\$12,737	\$302	\$603	\$1,995	\$11,672	\$34,746
Episode Length Less Than 1 Year	22,869	2.92%	\$52,256	\$1,946	\$6,525	\$26,034	\$71,610	\$134,949
Beneficiary Death in Episode	67,173	8.59%	\$44,207	\$1,424	\$5,076	\$21,926	\$62,679	\$117,685
Outlier Cases	14,290	1.83%	\$23,640	\$42	\$95	\$8,327	\$37,772	\$46,642
No Attributed Clinician (TIN-NPI Reporting Only)	254,972	32.59%	\$13,318	\$306	\$638	\$2,365	\$13,697	\$35,538
Recent Hospice Use	1,305	0.17%	\$14,394	\$312	\$905	\$2,871	\$10,664	\$38,755
TIN does not Meet Testing Volume Threshold	66,840	8.54%	\$14,031	\$360	\$666	\$1,994	\$11,527	\$37,708
TIN-NPI does not Meet Testing Volume Threshold	228,214	29.17%	\$14,675	\$332	\$626	\$2,082	\$12,996	\$41,661
Reportable Episodes (if all clinicians reported as TIN at the Testing Volume Threshold)	643,285	82.22%	\$9,511	\$297	\$567	\$2,871	\$8,112	\$26,454
Reportable Episodes (if all clinicians reported as TIN-NPI at the Testing Volume Threshold)	273,524	34.96%	\$8,480	\$280	\$541	\$1,486	\$6,527	\$23,700

Appendix A. Distributions of Measure Score

Figure 2: Distribution of Measure Score - TIN

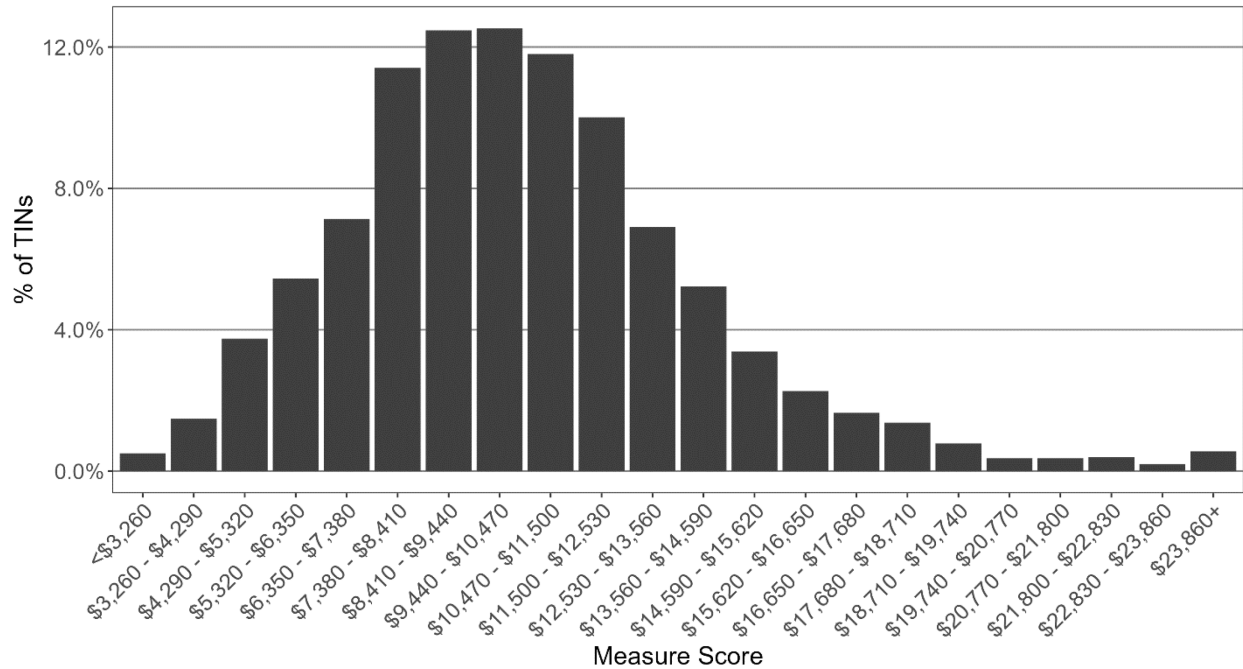
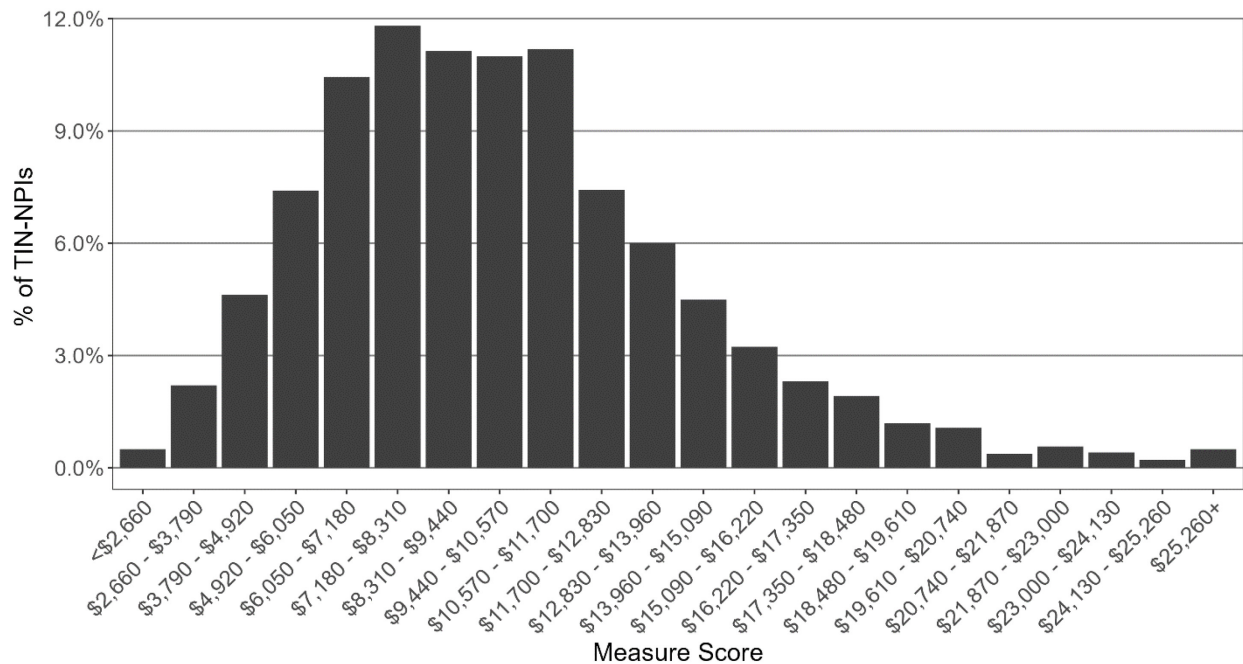


Figure 3: Distribution of Measure Score - TIN-NPI



Appendix B. Associations between Social Risk Factor Variables and Cost of Care for TIN-NPIs

Table B1: Associations of Available Social Risk Factor Variables and Cost of Care – TIN-NPI Reporting Level

Subgroup Risk Model	Variable	Coefficient (Standard Deviation, P-value)		
		Model 1: Base Model + Dual Status	Model 2: Base Model + Dual Status + Race	Model 3: Base Model + Dual Status + Race + AHRQ SES
No recent metastatic cancer diagnosis, metastatic drugs with Part D	Dual Status	0.23 (SD: 0.01, p: <0.001)	0.24 (SD: 0.01, p: <0.001)	0.24 (SD: 0.01, p: <0.001)
	Race - Asian	-	-0.01 (SD: 0.02, p: 0.78)	-0.01 (SD: 0.02, p: 0.75)
	Race - Black	-	0.01 (SD: 0.01, p: 0.25)	0.01 (SD: 0.01, p: 0.25)
	Race - Hispanic	-	-0.07 (SD: 0.03, p: 0.01)	-0.07 (SD: 0.03, p: 0.01)
	Race - North American Native	-	0.26 (SD: 0.06, p: <0.001)	0.26 (SD: 0.06, p: <0.001)
	Race - Others	-	0.02 (SD: 0.01, p: 0.18)	0.02 (SD: 0.01, p: 0.19)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.65)
No recent metastatic cancer diagnosis, metastatic drugs without Part D	Dual Status	0.46 (SD: 0.11, p: <0.001)	0.46 (SD: 0.11, p: <0.001)	0.47 (SD: 0.11, p: <0.001)
	Race - Asian	-	0.04 (SD: 0.05, p: 0.41)	0.05 (SD: 0.05, p: 0.3)
	Race - Black	-	-0.01 (SD: 0.01, p: 0.53)	-0.01 (SD: 0.01, p: 0.56)
	Race - Hispanic	-	0.03 (SD: 0.06, p: 0.59)	0.04 (SD: 0.06, p: 0.52)
	Race - North American Native	-	0.21 (SD: 0.07, p: <0.001)	0.21 (SD: 0.07, p: <0.001)
	Race - Others	-	0 (SD: 0.02, p: 0.87)	0 (SD: 0.02, p: 0.89)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.35)
Recent metastatic cancer diagnosis, metastatic drugs with Part D	Dual Status	0.39 (SD: 0.02, p: <0.001)	0.35 (SD: 0.02, p: <0.001)	0.35 (SD: 0.02, p: <0.001)
	Race - Asian	-	0.13 (SD: 0.05, p: 0.01)	0.12 (SD: 0.05, p: 0.02)

Subgroup Risk Model	Variable	Coefficient (Standard Deviation, P-value)		
		Model 1: Base Model + Dual Status	Model 2: Base Model + Dual Status + Race	Model 3: Base Model + Dual Status + Race + AHRQ SES
	Race - Black	-	0.15 (SD: 0.02, p: <0.001)	0.15 (SD: 0.02, p: <0.001)
	Race - Hispanic	-	0.12 (SD: 0.06, p: 0.04)	0.12 (SD: 0.06, p: 0.05)
	Race - North American Native	-	0.34 (SD: 0.12, p: <0.001)	0.34 (SD: 0.12, p: 0.01)
	Race - Others	-	-0.01 (SD: 0.03, p: 0.79)	0 (SD: 0.03, p: 0.86)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.79)
Recent metastatic cancer diagnosis, metastatic drugs without Part D	Dual Status	-0.08 (SD: 0.2, p: 0.71)	-0.07 (SD: 0.2, p: 0.71)	-0.07 (SD: 0.2, p: 0.72)
	Race - Asian	-	0.12 (SD: 0.12, p: 0.3)	0.09 (SD: 0.12, p: 0.46)
	Race - Black	-	-0.03 (SD: 0.03, p: 0.31)	-0.03 (SD: 0.03, p: 0.35)
	Race - Hispanic	-	-0.1 (SD: 0.14, p: 0.5)	-0.1 (SD: 0.14, p: 0.5)
	Race - North American Native	-	0.12 (SD: 0.15, p: 0.4)	0.13 (SD: 0.15, p: 0.39)
	Race - Others	-	0.01 (SD: 0.05, p: 0.84)	0 (SD: 0.05, p: 0.98)
	Race - White	-	ref	ref
	AHRQ SES Index	-	-	0 (SD: 0, p: 0.65)