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Hutchinson Institute for Cancer Outcomes Research

Community Cancer Care in Washington State

Methodology 2025

Fred Hutch Cancer Center

The Hutchinson Institute for Cancer Outcomes Research (HICOR®) is a scientific research institute based at Fred Hutch Cancer Center. HICOR's mission is to improve cancer prevention, detection and treatment in ways that will reduce the economic and human burden of cancer.

HICOR developed and released the Community Cancer Care in Washington State: Quality and Cost Report 2025 to improve quality and lower costs in cancer care. This supplement, Community Cancer Care in Washington State: Methodology 2025, is a companion document to that report and provides detailed information on how metrics were constructed, how patients are attributed to clinics, and how summary quality and cost scores were calculated.

This work has been reviewed by the Institutional Review Boards of Fred Hutch Cancer Center and Washington state, and is covered by data use agreements with the Centers for Medicare & Medicaid Services, Premera Blue Cross, Cambia Health Solutions Inc., Washington State Healthcare Authority, State of Washington Department of Health, Washington State Cancer Registry and the Cancer Surveillance System.

Acknowledgments

This report is a culmination of many years of collaboration with patients, providers, payers, researchers and guideline experts to define and measure value in cancer care. We would like to thank the individuals involved in HICOR's Value in Cancer Care (VCC) Working Groups, Patient Advisory Committee, Data Methods Committee and Steering Committee for helping us achieve community alignment in our priorities and our methodologies for performance measurement.

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How to cite this report

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Stakeholder Engagement

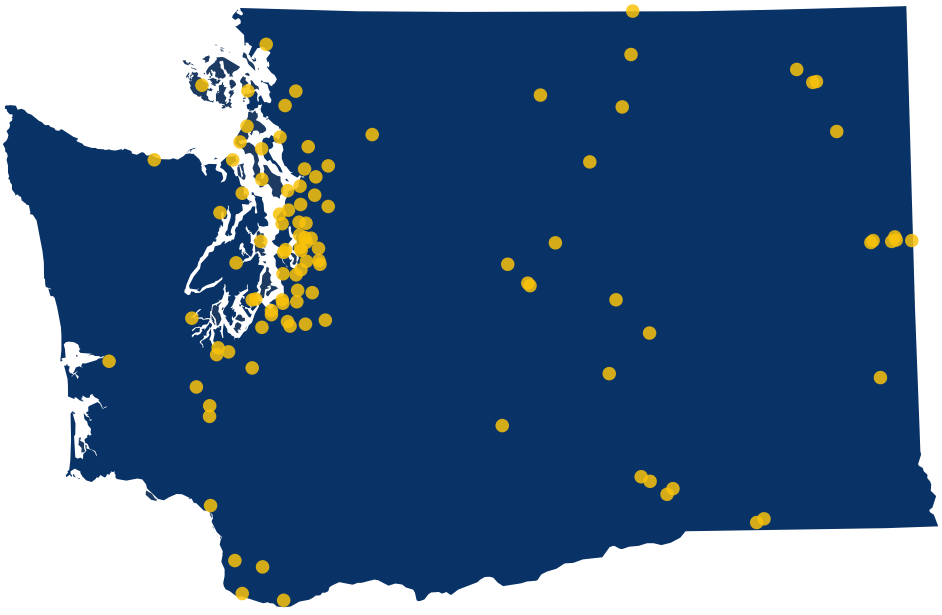
HICOR developed the quality and cost measures in this report in collaboration with hospitals and clinics delivering cancer care, health insurance plan administrators, patient partners, researchers, health care quality organizations, policymakers and government leaders in Washington state.

We based our community engagement practices on recommendations from national bodies such as the Centers for Medicare & Medicaid Services (CMS), the National Committee for Quality Assurance (NCQA) and the National Comprehensive Cancer Network (NCCN). These organizations encourage stakeholder involvement in the development process to ensure that measures are accurate, appropriately constructed and responsive to stakeholder needs.

HICOR has established standing committees to provide guidance on our reporting efforts, including a Steering Committee, Patient Advisory Committee and Data Methods Committee. The committees include representatives from the stakeholder groups noted here and meet regularly with the HICOR team to align HICOR's research agenda and measure development with community priorities. HICOR shares methodology and early results with these committees to guide interpretation and incorporate community feedback.

Our overarching goals for this effort are straightforward: identify opportunities to improve cancer care delivery, facilitate the sharing of best practices in our community and encourage collaboration between the oncology community and researchers in order to evaluate new models of care.

We are sincerely grateful to the cancer care providers, patient partners, health insurance representatives and others who have generously donated their time, expertise and perspective to this process. HICOR is committed to ongoing collaboration with our stakeholders to ensure that our work is meaningful and relevant to our community.



2014
1st Value in Cancer Care (VCC) Summit
Identified high-priority areas for value measure development

2015
2nd VCC Summit
Presented regional quality measures

2016
3rd VCC Summit
Presented regional quality and cost measures

2017
4th VCC Summit
Presented initial quality report for high-performing clinics

2018
5th VCC Summit
Publicly released the first Community Cancer Care in WA State: Quality and Cost Report

2019
6th VCC Summit
Presented on integrating the patient voice

2020
7th VCC Summit (Virtual)
Released Community Cancer Care in WA State: Medicaid Supplement

2023
8th VCC Summit
Added biomarker, genetic testing and timeliness of care measures in quality report

2024
9th VCC Summit
Presented on improving patient access to care

Methodology

HICOR followed national guidance and best practices for measure development and public reporting, drawing from the Centers for Medicare and Medicaid's Measure Management System,[1] the National Quality Forum's Measure Developer Guidebook[2] and performance measurement literature.[3]

METRIC SELECTION AND DEVELOPMENT

The measures used in the report represent priority areas identified by regional stakeholders and supported by evidence-based care guidelines issued by organizations such as the National Comprehensive Cancer Network (NCCN) and the American Society of Clinical Oncology (ASCO) and quality initiatives such as the Quality Oncology Practice Initiative (QOPI).[4] HICOR reviewed available metrics from national quality improvement programs in oncology such as QOPI, the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA),[5] the Oncology Care Model (OCM),[6] and the American Board of Internal Medicine (ABIM) / ASCO Choosing Wisely Campaign.[7] To develop the specifications for each individual metric, we reviewed the National Quality Forum (NQF) and the National Quality Measures Clearinghouse for similar metrics with published specifications. If specifications were not publicly available or there was a lack of consensus at the national level, we constructed our own algorithms with clinical and technical expert review.

HICOR metric specifications represent a refinement of national metrics due to our access to unique data sources and the database population size. Many national metric specifications are designed for measurements using electronic health records or use only health insurance claims. We were able to refine metric specifications by using clinical and insurance records available in our database, which links cancer registry data and insurance claims. Access to cancer registry data allowed for the addition of cancer stage as a risk adjustor and enabled the results to account for different stage mixes between clinics. To capture sufficient numbers for reporting quality in the regional population, we combined metrics of appropriate treatment across multiple cancers into a broad measure. To increase the statistical reliability of our measures, we have reported results over a three-year period, a performance period used by Centers for Medicare and Medicaid (CMS) and other quality reporting organizations.[8]

The measures provide a limited view of the larger, complex environment of cancer care. The report does not include all possible quality measures and does not directly measure patient experience.

DATA SOURCES AND MEASURE CONSTRUCTION

Data Sources

HICOR's database combines clinical information from two Washington state cancer registries with health utilization and cost data from health insurers in the state. The Washington State Cancer Registry (WSCR) and the Western Washington Cancer Surveillance System (CSS) collect comprehensive information on staging, initial treatment and survival for individuals diagnosed with malignancies in Washington state, excluding non-melanoma skin cancer. HICOR links data from these cancer registries with enrollment files from Premera Blue Cross, Regence BlueShield, Washington State Medicaid and Medicare. When an enrollment file matches a cancer registry file, HICOR extracts all health care claims for that individual, including inpatient and outpatient services and outpatient pharmacy claims.

Patient Population

The metrics include adult patients who were enrolled in a participating health insurance plan during the metric's time period of interest. Individuals without a known date of diagnosis and those diagnosed via autopsy or death certificate were excluded.

HEALTH INSURANCE PLANS

Premera Blue Cross

Regence BlueShield

Washington State Medicaid

Washington State Uniform Medical Plan

Medicare

CANCER REGISTRIES

Washington State Cancer Registry (WSCR)

Western Washington Cancer Surveillance System (CSS)

Reporting Years

This report includes measurement results for 2019 to 2021. However, some metric specifications require inclusion of individuals who were diagnosed before 2019 or who had part of their measurement period in 2018, in order to capture the primary period of care for the years 2019 to 2021.

Separate reporting for the Puget Sound region is presented with the most recent data we have available, with a primary period of care in the years 2021 to 2023.

Reporting years by measure:

- **Measure 1A and 1B: Appropriate Cancer Treatment**
  Diagnosis date between January 1, 2018, and December 31, 2020
  (Puget Sound region: 2020-2022)
- **Measure 1C: Somatic Mutation Testing**
  Date of diagnosis between January 1, 2019, and December 31, 2021
  (Puget Sound region: 2021-2023)
- **Measure 2: Hospitalization During Chemotherapy**
  Receipt of first outpatient chemotherapy between January 1, 2019, and December 31, 2021
  (Puget Sound region: 2021-2023)
- **Measure 3: Breast Cancer Tumor Marker Testing Following Treatment**
  Finished treatment (surgery, chemotherapy, radiation therapy)
  between January 1, 2019, and December 31, 2020
  (Puget Sound region: 2020-2022)
- **Measure 4: End-of-Life Care**
  Date of death between
  January 1, 2019, and December 31, 2021
  (Puget Sound region: 2021-2023)
- **Measure 5: Germline Testing**
  Date of diagnosis between
  January 1, 2019, and December 31, 2021
  (Puget Sound region: 2021-2023)
- **Measure 6: Timeliness of Care**
  Date of diagnosis between
  January 1, 2019, and December 31, 2021
  (Puget Sound region: 2021-2023)

Metric Specifications

Each metric has clinical specifications designed to capture the outcome measured. Appendix A provides the metric source, the exact outcome being measured, the eligible patient population and the time period used for attributing patients to clinics.

Methodology for Clinic-Level Results: Overview

Eligible Patients

- Washington state adult patients with cancer enrolled in:
  - Medicare
  - Premera Blue Cross
  - Regence BlueShield
  - Uniform Medical Plan
- Reporting Years: 2019-2021
- Additional specifications based on the particular measure

Eligible Clinics

- Attribute patients to clinics
- Clinics with at least 40 or 50 patients per metric

QUALITY

INDIVIDUAL METRICS

- Apply Hierarchical Generalized Linear (HGLM) statistical model
- Include risk adjustment if appropriate
- Clinic risk–standardized rate = $\left[\frac{\text{Clinic predicted rate}}{\text{Clinic expected rate}}\right] \times \text{Region average}$

QUALITY SCORE

- If lower score = higher quality, subtract region average from clinic risk–standardized rate
- If higher score = higher quality, subtract clinic risk–standardized rate from region average
- Clinic's quality score = sum of the above differences for each quality metric in the composite

COSTS

- Include all costs during the episode
- Winsorize costs at the 5th and 95th percentiles by cancer type
- Apply Hierarchical Generalized Linear (HGLM) statistical model
- Include risk adjustment
- Clinic risk–standardized average episode cost per patient = $\left[\frac{\text{Clinic predicted average episode cost per patient}}{\text{Clinic expected average episode cost per patient}}\right] \times \text{Region average}$

Display quality score against costs

Methodology for Clinic-Level Results

For individual quality metrics presented at the clinic level, we reported risk-standardized rates, which have been used for over a decade to assess hospital performance.[9,10,11,12] We followed national guidance and best practice principles in developing the risk-adjustment models, constructing a quality score summarizing clinic performance on quality measures, and determining patient attribution to clinics.

PATIENT ATTRIBUTION AND REPORTING REQUIREMENTS

Patient Attribution to Clinics

For each measure, we attribute patients to one clinic. Appendix B outlines the patient attribution specifications. The principle behind this methodology is to capture the clinic most likely to direct the majority of the patient's cancer care during the measure's period of interest. Clinics are identified using Tax ID Numbers (TINs) or CMS Certification Numbers (CCNs) on health insurance claims.

Minimum Number of Patients per Clinic

To improve statistical reliability, we require a minimum number of eligible patients for each measure. This requirement includes:

- At least 40 eligible patients in the Treatment (Measures 1A and 1B) and Follow-up (Measure 3) measures
- At least 50 eligible patients in the Hospitalization (Measure 2) and End of Life Care (Measure 4) measures

Standardizing Individual Quality Metrics

We calculate a clinic risk-standardized rate for each individual metric within a measure. The risk-standardized rate is calculated using the equation in the box to the right.

This calculation measures whether a clinic had higher or lower rates than expected given its patient mix. This ratio is then rescaled by the regional average for interpretation with respect to the average outcome in the region. For more details, see Appendix C.

Risk standardization accounts for differences in the numbers of patients per clinic, differences in patient characteristics across clinics, and outliers in the data. Appendix D includes more information about risk standardization and other technical specifications.

Summary Quality Score

The summary quality score represents a clinic's overall quality relative to the regional average. The summary quality score is calculated by first measuring the difference between a clinic's risk-standardized rate and the regional average for each individual metric within the measure, and then summing the differences for each quality metric. For more details, see Appendix C.

Cost

We calculate a clinic risk-standardized average episode cost per patient associated with each measure. Cost includes all reimbursements paid by health insurers during the episode and may include non-cancer costs. The calculation and rationale are similar to the clinic risk-standardized rate above. For more details, see Appendix C.

Summary Quality Score and Cost Display

We display the clinic-level quality score on the y-axis and cost on the x-axis to facilitate a comparison of these outcomes in our community.

$$\text{Clinic-level risk-standardized rate} = \left[\frac{\text{Predicted rate}}{\text{Expected rate}}\right] \times \text{Observed regional average}$$

Methodology for Medicaid Results

Differences in quality metrics were compared between patients with cancer under the age of 65 from the two largest commercial payers in the state and Medicaid. Patients who are dual enrolled in both Medicare and Washington State Medicaid are excluded from the population.

Quality metrics are categorized as either process or outcome measures. Process measures are used to determine if providers are following guidelines or protocols (e.g., providing chemotherapy within certain time frame). Outcome measures are used to determine if following a protocol or guideline has the desired effect (e.g., keeping patients out of the hospital during treatment). Outcome measures are often risk-adjusted for factors that may impact adherence. Process metrics are generally not risk-adjusted. The metrics used are listed below along with their type (process or outcome) and our risk adjustment methods.

Measure	Type
Recommended therapy for breast cancer based on HER2 status	Process
Recommended therapy for breast cancer based on ER/PR status	Process
Receipt of chemotherapy within 120 days of diagnosis for patients with stage III colon cancer	Process
Receipt of chemotherapy within 270 days of diagnosis for patients with stage II-III rectal cancer	Process
Receipt of chemotherapy within 60 days of surgery for stage II-IIIA lung cancer patients	Process
No bevacizumab use for metastatic tumors within three months of diagnosis	Process
Emergency department visits during chemotherapy	Outcome
Inpatient stays during chemotherapy	Outcome
Tumor marker testing for patients with breast cancer following treatment	Process (with risk adjustment)
Chemotherapy in last 14 days of life	Process
Multiple emergency department visits in the last 30 days of life	Outcome
Intensive care unit stay in last 30 days of life	Outcome
Hospice care three or more days prior to death	Process

Full details for each metric are included in the Measure Specifications section and Appendix A.

Outcome measures were adjusted for age, sex, comorbidities, stage, cancer site and treatment factors where appropriate. In line with national methodology for reporting quality measures, process measures of care are reported as unadjusted averages, with the exception of Measure 3: Follow-Up Testing After Treatment. P-values less than 0.05 are reported to indicate the measures where there is a statistically significant difference in quality between the Medicaid and commercial populations.

To determine statistical significance, we first propensity score weighted the Medicaid and commercial populations for each measure to account for broad population differences. Specifically, we used inverse propensity score weighting based on age, gender, Area Deprivation Index (ADI), cancer group, liquid tumor status, American Joint Committee on Cancer (AJCC) stage and 24 Hierarchical Condition Categories (HCCs) capturing comorbidities.[3,9] We estimated the likelihood of each cohort using a generalized boosted propensity model, which is augmented by machine learning.[13] A predetermined standardized mean difference of 0.2 was used to determine adequate balance between the Medicaid and commercial populations.[13] We included the propensity weighting in a Hierarchical Generalized Linear Model (HGLM) with a binary distribution and a logit link function. The methodology for clinic-level results included a similar HGLM model but without a propensity score weighting. The HLGM model was further risk adjusted for each measure according to the table above.

Our risk adjustors for each measure are similar to those included in clinic-level results with one exception (see Appendix D). We included HCCs in the Medicaid report due to sufficient numbers of patients in the Medicaid and commercial populations and the importance of accounting for differences in the health status of these cohorts.

Methodology References

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Measure Specifications

CLINIC-LEVEL MEASURES

STATE-LEVEL MEASURES

MEASURE 1A AND 1B

Recommended Cancer Treatment

Outcomes for patients with cancer are better when cancer care providers follow evidence-based recommendations for treatment. By measuring how well clinics follow recommendations for treating breast, colorectal and lung cancer, this measure provides insight into how well clinics follow cancer treatment recommendations overall.

METHODS

We reviewed more than 30 potential metrics for Recommended Cancer Treatment. For most metrics, our database had too few patients for meaningful statistical analysis. Therefore, in order to measure recommended treatment broadly, we combined several metrics to construct a new metric that applies to three of the most common cancer types: breast, colorectal and non-small cell lung cancer. The new combined metric is Recommended therapy based on cancer type.

Appendix A lists the metric definitions in greater detail, along with their sources.

The treatment period begins at the start of active treatment (surgery, chemotherapy or radiation therapy) and continues until there is a four-month gap with no recorded treatment. The period may end earlier if the patient died or treatment extended beyond 12 months.

For all metrics, the eligible population includes adult patients in Washington state who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare during the treatment period.

For Recommended therapy based on cancer type, the criteria applied to each metric are based on the cancer types listed below and recommended guidelines for treating that cancer.

Breast cancer:

For Recommended therapy based on HER2 status, the metric population ("denominator") is adult females with breast cancer whose HER2/neu status was recorded (either positive or negative), who were diagnosed with American Joint Committee on Cancer (AJCC) stage T1c or II-III cancer and had insurance coverage including a claim for chemotherapy within 365 days of diagnosis. The treatments of interest ("numerator") were receipt of trastuzumab, lapatinib or pertuzumab within 365 days of diagnosis.

For Recommended therapy based on ER/PR status, the metric population ("denominator") is females ages 18-79 with AJCC stage IB-III cancer and a record of their estrogen-receptor/progesterone-receptor (ER/PR) status (positive or negative) who had health insurance coverage for 120 days (for ER and PR negative patients) or 365 days (for ER or PR positive patients) after diagnosis. ER/PR negative patients were included only if they had a lumpectomy or mastectomy in the 120 days after diagnosis. The treatment of interest ("numerator") depended on the ER/PR status of the patient and was either 1) for ER/PR negative patients, receiving two or more chemotherapy agents within 120 days of diagnosis, with the second agent administered within three days of the first or; 2) for ER/PR positive patients receiving hormone therapy within 365 days of diagnosis.

Colorectal cancer:

For Receipt of chemotherapy within 120 days of diagnosis for patients with stage III colon cancer, the metric population ("denominator") is patients ages 18-79 with AJCC stage III colon cancer who had health insurance coverage for 120 days after diagnosis. The treatment of interest ("numerator") is receipt of chemotherapy within 120 days of diagnosis.

For Receipt of chemotherapy within 270 days of diagnosis for patients with stage II-III rectal cancer, the metric population ("denominator") is patients with AJCC stage II or III rectal cancer who had health insurance coverage for 270 days after diagnosis. The treatment of interest ("numerator") is receipt of chemotherapy within 270 days of diagnosis.

Non-small cell lung cancer:

For Receipt of chemotherapy within 60 days of surgery, the metric population ("denominator") is non-small cell lung patients with cancer, AJCC stage II–IIIA, who had health insurance coverage and a record of lung cancer resection surgery within two months of diagnosis. The treatment of interest ("numerator") is receipt of chemotherapy within 60 days of surgery.

For No bevacizumab use for metastatic tumors within three months of diagnosis, the metric population ("denominator") is patients with AJCC stage IV or registry stage distant non-small cell lung cancer with squamous histology who had health insurance coverage from diagnosis to either 90 days after diagnosis or death. The treatment of interest ("numerator") is receipt of bevacizumab within 90 days of diagnosis.

CLINIC ATTRIBUTION

Patients were assigned to clinics during the treatment period using the Clinic Attribution methodology specified in Appendix B.

SUMMARY QUALITY SCORE

The summary quality score indicates a clinic's overall performance on all relevant metrics relative to the regional average. The score is calculated using a two-step process: measuring the difference between a clinic's standardized rate and the regional average for each metric, and then summing the differences for each quality metric. See Appendix C for more details.

COST

The cost is the amount paid by insurers to all health care providers for patients with cancer included in the measure. See Appendix C for more details.

RISK ADJUSTMENT

Risk standardization accounts for differences in the number of patients per clinic, differences in patient characteristics across clinics, and outliers in the data.

"Process metrics" concern recommended use or non-use of tests or treatments, and thus are not typically risk adjusted. We adjusted each metric for cancer type to account for differences in the percentage of patients with breast, colorectal and lung cancer across providers.

The charts on the next two pages list the risk adjustors, including those made to cost during the treatment period.

For more detail about risk adjustment see Appendix D.

MEASURE LIMITATIONS

Quality:

- These metrics offer a limited snapshot of treatment. Other important components of care are not included in this measure.
- These metrics do not account for individual patient preferences for treatment. Some patients may opt not to receive treatment.

Cost:

- Costs are adjusted for receipt of chemotherapy, radiation and surgery but do not distinguish among the variations in types of treatment.
- The cost measure does not include patients' out-of-pocket responsibility for copays or deductibles.

MEASURE 1A

Recommended Treatment for Breast, Colorectal and Lung Cancer

MEASURE 1A: RECOMMENDED TREATMENT FOR BREAST, COLORECTAL AND LUNG CANCER

Recommended therapy based on cancer type

Breast Cancer

- Receipt of chemotherapy within 120 days of diagnosis for ER/PR negative patients (stage IC-III)
- Hormone therapy (tamoxifen or aromatase inhibitor) within 365 days of diagnosis for ER/PR positive patients (stage IC-III)
- Receipt of trastuzumab based on HER2 status (stage IC-III)

Colorectal Cancer

- Receipt of chemotherapy within 120 days of diagnosis for patients with colon cancer (stage III)
- Receipt of chemotherapy within 270 days of diagnosis for patients with rectal cancer (stage II-III)

Non-Small Cell Lung Cancer

- Receipt of chemotherapy within 60 days of surgery (stage II-IIIA)
- No bevacizumab use for metastatic tumors within three months of diagnosis

Population: Patients with breast, colorectal and lung cancer undergoing cancer treatment

Reporting Years: 2019–2021

Time Period: The treatment period begins at the start of active treatment (surgery, chemotherapy or radiation therapy) and continues until there is a four-month gap in treatment. The period may end earlier if the patient died or treatment extended beyond 12 months.

Measure 1A Risk Adjustors: Recommended Treatment for Breast, Colorectal and Lung Cancer		
	Recommended Therapy	Cost
Age (continuous)		X
Medicare Indicator		X
Medicare × Age		X
Colorectal Cancer Indicator	X	
Lung Cancer Indicator	X	X
# Days in Period		X

1. Reference Appendix D for Charlson Score.

MEASURE 1B

Recommended Treatment for Breast Cancer

MEASURE 1B: RECOMMENDED TREATMENT FOR BREAST CANCER

Recommended therapy based on ER/PR and HER2 status for breast cancer

- Receipt of chemotherapy within 120 days of diagnosis for ER/PR negative patients (stage IC-III)
- Hormone therapy (tamoxifen or aromatase inhibitor) within 365 days of diagnosis for ER/PR positive patients (stage IC-III)
- Receipt of trastuzumab based on HER2 status (stage IC-III)

Population: Patients with breast cancer undergoing cancer treatment

Reporting Years: 2019–2021

Time Period: The treatment period begins at the start of active treatment (surgery, chemotherapy or radiation therapy) and continues until there is a four-month gap in treatment. The period may end earlier if the patient died or treatment extended beyond 12 months.

Measure 1B Risk Adjustors: Recommended Treatment for Breast Cancer		
	Recommended Therapy Based on ER/PR & HER2 Status	Cost
Age (continuous)		X
Area Deprivation Index (ADI)[2]		X
Medicare Indicator		X
# Days in Period		X

MEASURE 1C

Somatic Mutation Testing for Metastatic Lung and Colorectal Cancer

National guidelines recommend biomarker testing to identify mutations in the tumor for patients with metastatic lung and colorectal cancer. This testing is important because many newer prescribed treatments specifically target certain mutations that can only be identified through testing. This measure provides insight into how well clinics follow biomarker testing recommendations.

METHODS

Based on national guidelines, we created two somatic mutation testing measures, one each for metastatic lung and metastatic colorectal cancer. For both metrics, our database had too few patients for meaningful statistical analysis. Therefore, in order to measure recommended somatic mutation testing broadly, we combined both metrics to a new combined metric, Somatic Mutation Testing for Metastatic Lung and Colorectal Cancer.

The metric is described here and in the box on this page. Appendix A lists the metric definition in greater detail, along with its sources.

For this metric, the eligible population ("denominator") is adults in Washington state with non-small cell lung cancer who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare during the testing period. The testing period begins two months prior to the patient's cancer diagnosis and continues for four (lung cancer) or six (colorectal cancer) months after diagnosis.

Patients were included if cancer registry records listed them as having metastatic disease (AJCC stage IV or SEER stage distant) at diagnosis.

Persons were counted as having been tested ("numerator") if they had one or more somatic mutation tests (lung: NGS, EGFR, ALK, or ROS1; colorectal: MSI, MMR IHC, KRAS, NRAS or BRAF) during the testing period.

CLINIC ATTRIBUTION

Patients were assigned to clinics during the testing period using the Clinic Attribution methodology specified in Appendix B.

RISK ADJUSTMENT

Since the HGLM model with risk-adjusted rates did not converge, measure 1C is reported at the clinic level using unadjusted utilization rates.

MEASURE 1C: SOMATIC MUTATION TESTING FOR METASTATIC LUNG AND COLORECTAL CANCER

Somatic mutation testing for metastatic lung cancer

- Receipt of NGS, EGFR, ALK or ROS1 test

Somatic mutation testing for metastatic colorectal cancer

- Receipt of MSI, MMR IHC, KRAS, NRAS or BRAF test

Population: Patients with non-small cell lung or colorectal cancer with metastatic disease

Reporting Years: 2019–2021

Time Period: The testing period begins two months prior to diagnosis and continues through four (lung) or six (colorectal) months following diagnosis.

MEASURE LIMITATIONS

- This measure does not account for individual patient preferences or clinical nuance. Some patients, for example, may opt not to receive testing even if offered; others may choose to pursue palliative care in which case testing will not help to guide care.
- While uncommon, sometimes insurers deny payment for testing or the lab chooses not to send a bill for testing. In those situations, the test was completed but is not recorded in insurance claims.

MEASURE 2

Hospitalization During Chemotherapy

Hospitalization during chemotherapy includes visits to the emergency department or an inpatient hospital stay (excluding stays for cancer-directed surgeries) during the time that a patient receives chemotherapy. Cancer clinics that are the most successful at managing their patients' symptoms during chemotherapy will have the lowest rates of emergency department and hospital stays.

METHODS

The Hospitalization During Chemotherapy measure employs two metrics: Emergency department (ED) visits during chemotherapy and Inpatient (IP) stays during chemotherapy.

The metrics are described in this text and in the box on this page. Appendix A lists the metric definitions in greater detail, along with their sources.

For both metrics, the eligible population ("denominator") is adult patients in Washington state who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare at the time of their diagnosis through six months following the start of chemotherapy. Patients who received a bone marrow transplant were excluded.

The outcome of interest for Emergency department (ED) visits during chemotherapy is an ED visit for any reason within 180 days of the first chemotherapy claim ("numerator"). Patients who were admitted to the hospital at the time of their ED visit were not included in the ED metric.

The outcome of interest for Inpatient (IP) stays during chemotherapy is a hospital IP admission for any reason except cancer-directed surgeries within 180 days of the first chemotherapy treatment ("numerator").

CLINIC ATTRIBUTION

Patients were assigned to clinics during the six-month period following the start of chemotherapy using the Clinic Attribution methodology specified in Appendix B.

SUMMARY QUALITY SCORES

The summary quality score indicates a clinic's overall performance on all relevant quality metrics relative to the regional average. The score is calculated using a two-step process: measuring the difference between a clinic's risk-standardized rate and the regional average for each metric and then summing the differences for each quality metric. See Appendix C for more details.

MEASURE 2: HOSPITALIZATION DURING CHEMOTHERAPY

Emergency department (ED) visits during chemotherapy

- ED visit without subsequent inpatient admission within six months of first chemotherapy

Inpatient (IP) stays during chemotherapy

- Hospital IP admission for any reason within six months of first chemotherapy

Population: Patients with cancer receiving chemotherapy

Reporting Years: 2019–2021

Time Period: Six months following the start of chemotherapy

COST

Costs for the six-month period following the start of chemotherapy are measured and compared against the summary quality score. The cost is the amount paid by insurers to all health care providers for the populations included in the combined metric. See Appendix C for more details on cost methodology.

RISK ADJUSTMENT

As "outcome metrics," ED visits or IP stays are typically risk adjusted to account for patient factors that might vary from clinic to clinic and also affect the likelihood of an event. We also adjusted for cancer type to account for differences in the percentage of patients with breast, colorectal, prostate and liquid tumors treated in the cancer clinics. The chart on the next page lists the risk adjustors, including those made to cost during chemotherapy.

For more details about risk adjustment, see Appendix D.

MEASURE LIMITATIONS

Quality:

- The metrics measure all hospital ED and IP admissions, excluding IP admissions for cancer-directed surgery. It is therefore possible that some of the ED and IP admissions were for reasons unrelated to the patient's cancer treatment.
- Risk adjustment is designed to account for factors that are outside of the cancer clinics' control that could influence ED and IP admissions. Some of these factors (such as the availability of family support) are not available in our databases and therefore pose a limitation in our methodology.

Cost:

- The cost measure does not include patients' out-of-pocket responsibility for copays or deductibles.

Measure 2 Risk Adjustors: Hospitalization During Chemotherapy			
	ED During Chemo	IP During Chemo	Cost
Age (continuous)			X
Sex	X		X
Charlson Score (0, 1, 2+)[1]	X	X	X
Medicare Indicator	X		X
Medicare × Age			X
Medicare × Dual Eligibility	X		X
AJCC Stage	X	X	X
Breast Cancer Indicator	X	X	
Colorectal Cancer Indicator	X	X	X
Lung Cancer Indicator			X
Prostate Cancer Indicator	X	X	X
Gynecologic Cancer Indicator			X
Bladder Cancer Indicator			X
Melanoma Cancer Indicator			X
Pancreatic Cancer Indicator			X
Kidney Cancer Indicator			X
Liver Cancer Indicator			X
Liquid Tumor Indicator		X	X
# Days in Period		X	X
# Chemo Administrations			X
Radiation Receipt Indicator			X
Surgery Receipt Indicator	X	X	X

1. Reference Appendix D for Charlson Score.

MEASURE 3

Breast Cancer Tumor Marker Testing Following Treatment

Studies have shown no benefit from the routine use of tumor marker testing for patients with early-stage cancers who were treated with curative intent and have no symptoms. Unnecessary testing may lead to misdiagnosis and overtreatment, as well as increased costs.

METHODS

The Breast Cancer Tumor Marker Testing Following Treatment measure includes one metric: Breast cancer tumor marker testing following treatment.

The metric is described here and in the box on this page. Appendix A lists the metric definition in greater detail, along with its sources.

The follow-up period focuses on the initial (13-month) period after the end of active treatment (surgery, chemotherapy or radiation therapy), but may end earlier if the patient died or restarted active treatment. Patients must have a four-month gap in active treatment to be considered to have completed active treatment.

For this metric, the eligible population ("denominator") is adult women in Washington state with breast cancer who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare at the time of their diagnosis through the end of the initial follow-up period. Patients were diagnosed at an early stage (AJCC stage I-IIIA) and received curative treatment.

For Breast cancer tumor marker testing following treatment, the measure of interest ("numerator") is patients who had a tumor marker test (cancer antigen 15-3 [CA 15-3], cancer antigen 27.29 [CA 27.29], or carcinoembryonic antigen [CEA]) during the defined follow-up period.

MEASURE 3: BREAST CANCER TUMOR MARKER TESTING FOLLOWING TREATMENT

Breast cancer tumor marker testing following treatment

- Serum tumor marker test (CEA, CA 15-3, CA 27.29) for breast cancer (stage I-IIIA) during first 13 months of follow-up

Population: Patients with reast cancer who completed active treatment

Reporting Years: 2019–2021

Time Period: The follow-up period focuses on the initial (13-month) period after the end of active treatment (surgery, chemotherapy or radiation therapy), but may end earlier if the patient died or restarted active treatment. Patients must have a four-month gap in active treatment to be considered to have completed treatment.

CLINIC ATTRIBUTION

Patients were assigned to clinics during the initial follow-up period using the Clinic Attribution methodology specified in Appendix B.

SUMMARY QUALITY SCORE

The summary quality score indicates a clinic's overall performance on all relevant metrics relative to the regional average. The score is calculated using a two-step process: first, measuring the difference between a clinic's standardized rate and the regional average for each metric; second, summing the differences for each quality metric. See Appendix C for more details.

3: BREAST CANCER TUMOR MARKER TESTING FOLLOWING TREATMENT

COST

Costs for the initial follow-up period are measured and compared against the summary quality score. The cost is the amount paid by insurers to all health care providers for the patients with cancer included in the combined metric. See Appendix C for additional cost methodology.

RISK ADJUSTMENT

Risk standardization accounts for differences in the number of patients per clinic, differences in patient characteristics across clinics, and outliers in the data.

"Process metrics" concern recommended use or non-use of tests or treatments, and thus are not risk adjusted. Cost metrics are typically risk adjusted to account for patient factors that might vary from clinic to clinic and also affect the likelihood of variation in cost. The chart on this page lists the risk adjustors for cost during the follow-up period.

For more details about risk adjustment, see Appendix D.

MEASURE LIMITATIONS

Quality:

- This metric focuses on use of non-recommended tumor marker testing for asymptomatic patients. In some cases, tumor marker tests are recommended to evaluate a patient with symptoms or exam findings that are suggestive of a recurrent or new cancer. The insurance claims database cannot distinguish between tests that were done to evaluate symptoms and tests that were performed on patients with no symptoms.
- These metrics do not capture recommended follow-up care.

Measure 3 Risk Adjustors: Breast Cancer Tumor Marker Testing Following Treatment		
	BC Tumor Marker	Cost
Age (continuous)		X
Race		X
Charlson Score (0, 1, 2+)[1]		X
Area Deprivation Index (ADI)[2]		X
Medicare Indicator		X
Medicare × Age		X
Medicare × Dual Eligibility		X
AJCC Stage		X

1. Reference Appendix D for Charlson Score.

MEASURE 4

End-of-Life Care

Aggressive cancer-directed treatment for patients with advanced, incurable cancer can be harmful, traumatic and costly without providing benefit. Studies have shown that symptom-focused palliative care is much more beneficial to patients at this stage of their disease.

METHODS

The End-of-Life Care measure employs four metrics: Chemotherapy in the last 14 days of life, Multiple emergency department (ED) visits in the last 30 days of life, Intensive care unit (ICU) stay in the last 30 days of life and Hospice care three or more days before death.

The metrics are described below and in the box on this page. Appendix A lists the metric definitions in greater detail, along with their sources.

For all four metrics, the eligible population ("denominator") is adult patients in Washington state with solid tumors who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare in the last six months of life. Patients were diagnosed with solid tumor cancers (no leukemia, lymphoma or myeloma), AJCC stage II-IV or registry stage regional or distant, at the time of their diagnosis.

For Chemotherapy in the last 14 days of life, the measure of interest ("numerator") is patients who received chemotherapy in the last 14 days of life.

For Multiple emergency department (ED) visits in the last 30 days of life, the measure of interest ("numerator") is patients who had more than one ED visit in the last 30 days of life.

For Intensive care unit (ICU) stay in the last 30 days of life, the measure of interest ("numerator") is patients who had a hospital ICU admission for any reason in the last 30 days of life.

For Hospice care three or more days before death, the measure of interest ("numerator") is patients who had two or more claims for inpatient or outpatient hospice care, with the first claim at least three days before death.

CLINIC ATTRIBUTION

Patients were assigned to clinics providing care in the last 180 days of life using the Clinic Attribution methodology specified in Appendix B.

MEASURE 4: END-OF-LIFE CARE

Chemotherapy in the last 14 days of life

- Receipt of any chemotherapy in the last 14 days of life

Multiple emergency department (ED) visits in the last 30 days of life

- More than one ED visit in the last 30 days of life

Intensive care unit (ICU) stay in the last 30 days of life

- Hospital ICU admission for any reason in the last 30 days of life

Hospice care three or more days prior to death

- Two or more inpatient or outpatient hospice encounters, with the first encounter at least three days prior to death

Population: Patients with cancer at end of life

Reporting Years: 2019–2021

Time Period: Patient's last 30 days of life.

SUMMARY QUALITY SCORE

The summary quality score indicates a clinic's overall performance on all relevant metrics relative to the regional average. The score is calculated using a two-step process: first measuring the difference between a clinic's standardized rate and the regional average for each metric; second, summing the differences for each quality metric. See Appendix C for more details.

COST

Costs for the last 30 days of life are measured and compared against the summary quality score. The cost score is the amount paid by insurers to all health care providers for the population included in the combined metric. See Appendix C for additional cost methodology.

RISK ADJUSTMENT

As "process metrics," chemotherapy and hospice care at the end of life are not risk adjusted. The "outcome metrics," multiple ED visits and ICU stays, are typically risk adjusted to account for patient factors that might vary from clinic to clinic and also affect the likelihood of the event of interest. The chart on this page lists the risk adjustors used for cost at end of life.

For more details about risk adjustment, see Appendix D.

MEASURE LIMITATIONS

Quality:

- Patients have a variety of preferences for chemotherapy and hospice use at the end of life. The metrics do not account for individual preferences.
- The population includes patients with cancer who died from any cause, not just cancer. Sometimes, patients die unexpectedly from severe adverse events, even when performance status is good and they are early in the disease course. To reduce the impact of this limitation, patients who had local-stage disease at the time of diagnosis were excluded from the analyses.
- In some cases, the cancer clinic may not have been managing the patient at the end of life. Providers who are multi-specialty or who offer primary care services may be more likely to manage patient care at the end of life.

Cost:

- The cost measure does not include patients' out-of-pocket responsibility for copays or deductibles.

Measure 4 Risk Adjustors: End of Life Care				
	Chemo in Last 14 Days and Hospice	Multiple ED in Last 30 Days	ICU in Last 30 Days	Cost
Age (continuous)		X	X	X
Sex			X	
Race		X		
Charlson Score[1] (0, 1, 2+)		X	X	X
Area Deprivation Index (ADI)[2]		X		X
Medicare Indicator				X
Medicare × Age				X
Medicare × Dual Eligibility				X
AJCC Stage			X	X
Colorectal Cancer Indicator		X		
Lung Cancer Indicator			X	
Prostate Cancer Indicator				X

1. Reference Appendix D for Charlson Score.

2. University of Wisconsin School of Medicine and Public Health. Area Deprivation Index. Available at: https://www.neighborhoodatlas.medicine.wisc.edu/

MEASURE 5 - STATE-LEVEL REPORTING

Germline Testing

Clinical practice guidelines recommend germline testing for patients with breast, ovarian, pancreatic and prostate cancers. Testing enables physicians and their patients to identify inherited mutations that may help guide treatment and monitoring and help family members understand their risk of cancer. Information about inherited mutations can help patients and their relatives make choices about treatment and the frequency of cancer screenings.

METHODS

The Germline Testing measure employs four metrics: Germline Testing for Breast Cancer, Germline Testing for Ovarian Cancer, Germline Testing for Pancreatic Cancer and Germline Testing for Prostate Cancer.

The metrics are described below and in the box on this page. Appendix A lists the metric definitions in greater detail, along with their sources.

For all four metrics, the eligible population ("denominator") is adult patients in Washington state who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare in the two months prior to being diagnosed with breast, ovarian, pancreatic or prostate cancer and continues through 24 months following diagnosis. The criteria applied to each metric are based on the cancer types listed below and recommended guidelines for testing that cancer.

Breast cancer:

For Germline Testing for Breast Cancer, the metric population ("denominator") are adult females diagnosed with breast cancer under the age of 50, a female with "triple negative" (ER, PR and HER2 negative) breast cancer diagnosed at any age and men diagnosied with breast cancer at any age. The testing of interest ("numerator") was receipt of a BRCA 1 or BRCA 2 test in the two months prior to diagnosis through 24 months following diagnosis.

Ovarian cancer:

For Germline Testing for Ovarian Cancer, the metric population ("denominator") is adults with ovarian, fallopian tube or peritoneum cancer. The testing of interest ("numerator") was receipt of any germline test in the two months prior to diagnosis through 24 months following diagnosis.

Pancreatic cancer:

For Germline Testing for Pancreatic Cancer, the metric population ("denominator") is adults with adenocarcinoma of the pancreas. The testing of interest ("numerator") was receipt of any germline test in the two months prior to diagnosis through 24 months following diagnosis.

MEASURE 6: GERMLINE TESTING

Germline testing for breast cancer

- Receipt of BRCA1/2 test for male, triple negative or patients aged less than 50 with breast cancer

Germline testing for ovarian cancer

- Receipt of germline test for patients with ovarian, fallopian tube or peritoneum cancer

Germline testing for pancreatic cancer

- Receipt of germline test for patients with adenocarcinoma of the pancreas

Germline testing for prostate cancer

- Receipt of germline test for patients with metastatic, regional (node-positve) or high- or very-high-risk localized prostate cancer

Population: Patients with breast, ovarian, pancreatic and prostate cancer who meet guidelines for germline testing

Reporting Years: 2019–2021

Time Period: The testing period begins two months prior to diagnosis and continues through 24 months following diagnosis.

Prostate cancer:

For Germline Testing for Prostate Cancer, the metric population ("denominator") is adults with prostate cancer who were diagnosed with metastatic, node-positive regional, very-high-risk localized, or high-risk localized stage disease (see NCCN guidelines for Prostate Cancer). The testing of interest ("numerator") was receipt of any germline test in the two months prior to diagnosis through 24 months following diagnosis.

FINDINGS BY PATIENT FACTORS

All four Germline Testing measures are presented by age and insurance type of the patient. Additionally, the Germline Testing for Breast Cancer metric is presented by race/ethnicity.

MEASURE LIMITATIONS

- These measures does not account for individual patient preferences or clinical nuance. Some patients may opt not to receive testing. Others may not be able to complete a consultation with a geneticist or genetic counselor in spite of referral, resulting in delayed or lack of testing.
- While uncommon, sometimes insurers deny payment for testing or the lab chooses not to send a bill for testing. In those situations, the test may not have been completed due to lack of coverage or was completed but is not recorded in insurance claims.

MEASURE 6 - STATE-LEVEL REPORTING

Timeliness of Care

Studies have shown that shorter times from diagnosis to first treatment can lead to better outcomes. Measuring how quickly patients begin cancer treatment can help clinics understand this important benchmark and provides insights into potential disparities in care.

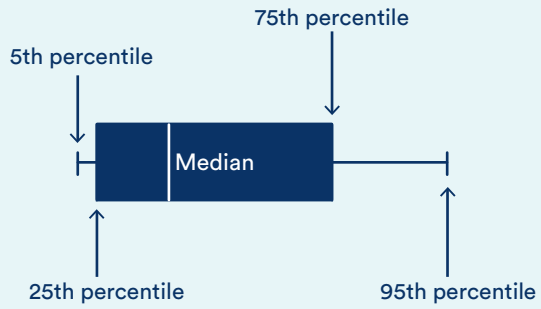
METHODS

The Timeliness of Care measure includes one metric: Time to Start of Treatment.

The metric is described here and in the box on this page. Appendix A lists the metric definition in greater detail.

For this metric, the eligible population is adults in Washington state with solid tumors who were enrolled with Premera Blue Cross, Regence BlueShield, the Washington State Uniform Medical Plan or Medicare one month prior to cancer diagnosis through 12 months following diagnosis. Patients were diagnosed with metastatic disease (AJCC stage IV or SEER stage distant) and initial treatment was chemotherapy or radiation therapy. Treatment was required to start within 12 months of diagnosis.

For Time to Start of Treatment, the measure of interest is the median number of days between a patient's first visit to an oncology clinic (no more than 30 days prior to diagnosis) and the start of chemotherapy or radiation therapy. If the patient visited multiple oncology clinics, the clinic showing the greatest number of visits was selected.



MEASURE 7: TIMELINESS OF CARE

Time to start of treatment

- Median number of days between first visit at an oncology clinic and date of first treatment

Population: Patients with cancer with metastatic disease who start chemotherapy or radiation therapy

Reporting Years: 2019–2021

Time Period: Initial treatment period, up to 12 months

FINDINGS BY PATIENT FACTORS

The Timeliness of Care measure is presented by cancer site, insurance type, race/ethnicity and the area depravation index (ADI)[1] of the patient. Results are presented for the 5th, 25th, 50th (Median), 75th and 95th percentiles. See the Legend on this page for details.

MEASURE LIMITATIONS

- This measure does not account for individual patient preferences. Some patients and their physicians may opt to delay treatment for clinical reasons such as those related to other procedures, management of comorbidities and patient scheduling.

1 Reference Appendix D for ADI.

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Appendices

Appendix A: Individual Metric Definitions

General inclusion criteria:

- Diagnosed with or treated for cancer in Washington state
- Known date of diagnosis, and not diagnosed at autopsy or by death certificate
- Enrolled in Premera Blue Cross, Regence BlueShield, WA State Medicaid, WA State Uniform Medical Plan or Medicare

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 1A: Recommended Cancer Treatment for Breast, Colorectal and Lung Cancer (Summary Quality Score)				
Recommended therapy based on cancer type	*See below for appropriate therapy metrics for each cancer type*			
Breast Cancer				
Recommended therapy based on ER/PR and HER2 status	**MACRA** #450 **OCM**-10 **QOPI** BR55 **NQF** #1858	• HER2/neu positive: Claim for trastuzumab, lapatinib or pertuzumab within 365 days of diagnosis • HER2/neu negative: No claim for trastuzumab, lapatinib or pertuzumab within 365 days of diagnosis	• Age 18+ • Female • Breast cancer • First or only cancer • AJCC stage T1c or AJCC stage II-III breast cancer • Known HER2/neu status • Alive 365 days after diagnosis • Medical coverage in 12 months following diagnosis • Claim for chemotherapy within 365 days of diagnosis • Exclude patients receiving anthracycline-based chemotherapy or radiation therapy in days 335-365 following diagnosis	HICOR Treatment Period*
	OCM-9 **QOPI** BR53 **NQF** #0559	• ER/PR Negative: Claim for two or more chemotherapy agents within 120 days of diagnosis; second agent given within three days of first agent	• Age 18–79 • Female • Breast cancer • First or only cancer • Known stage AJCC T1cN0M0 or IB-III breast cancer • Known ER and PR status • Alive 120 days (ER/PR negative) or 365 days (ER/PR positive) after diagnosis • Exclude phyllodes (9020) and rare (8940, 8950, 8980, 8981) histology types • Exclude tumors size ≤1cm2 & AJCC N0 • Alive with medical coverage for 120 days (ER/PR negative) or 365 days (ER/PR positive) after diagnosis • ER/PR negative: Lumpectomy or mastectomy in the first 120 days from diagnosis • ER/PR positive: Exclude patients receiving chemotherapy or radiation therapy in days 335-365 after diagnosis; exclude patients who received oophorectomy in year following diagnosis	HICOR Treatment Period*
	OCM-11 **QOPI** BR58 **QOPI** BR59 **NQF** #0220 **NQF** #0387 **PQRS** #71	• ER/PR Positive: Hormone therapy (tamoxifen, aromatase inhibitor or as defined by cancer registry) within 365 days of diagnosis		

* See page 32 for definitions of HICOR Treatment Period and HICOR Follow-up Period

Appendix A: Individual Metric Definitions

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Colorectal Cancer				
Receipt of chemotherapy within 120 days of diagnosis for patients with stage III colon cancer	**OCM**-8 **QOPI** CRC68 **NQF** #0223 **NQF** #0385	• Claim for chemotherapy within 120 days of diagnosis	• Age 18–79 • Colon cancer • First or only cancer • AJCC stage III • Alive 120 days after diagnosis • Medical coverage for 120 days after diagnosis	HICOR Treatment Period*
Receipt of chemotherapy within 270 days of diagnosis for patients with stage II-III rectal cancer	**QOPI** CRC72	• Claim for chemotherapy within 270 days of diagnosis	• Age 18–79 • Rectal cancer • First or only cancer • AJCC stage II-III • Alive 270 days after diagnosis • Medical coverage for 270 days after diagnosis	HICOR Treatment Period*
Non-Small Cell Lung Cancer				
Receipt of chemotherapy within 60 days of surgery	**QOPI** NSCLC80 & 81	• Claim for chemotherapy within 60 days of curative surgery	• Age 18+ • Non-small cell lung cancer • First or only cancer • AJCC stage II-IIIA • Claim for curative surgery • Medical coverage from diagnosis to two months following surgery	HICOR Treatment Period*
No bevacizumab use for metastatic tumors within three months of diagnosis	**QOPI** NSCLC86a	• No claim for bevacizumab within three months of diagnosis	• Age 18+ • Non-small cell lung cancer • First or only cancer • AJCC stage IV or registry stage distant • Squamous histology • Medical coverage from diagnosis to three months after diagnosis or death	HICOR Treatment Period*
Measure 1B: Recommended Treatment for Breast Cancer (Summary Quality Score)				
Recommended therapy based on HER2 status		*See the above measure Recommended Treatment for Breast, Colorectal and Non-Small Cell Lung Cancer for specifications related to breast cancer quality metrics on page 28.*		
Recommended therapy based on ER/PR status				
Measure 1C: Somatic Mutation Testing for Metastatic Lung and Colorectal Cancer				
Somatic mutation testing for metastatic lung cancer	**NCCN** guidelines for non-small cell lung cancer	• Claim for NGS, EGFR, ALK or ROS1 in the two months prior to diagnosis through four months after diagnosis	• Age 18+ • Non-small cell lung cancer • First or only cancer • Includes AJCC stage IV or SEER stage distant • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through four months following diagnosis	Start: Two months prior to diagnosis End: Four months after diagnosis
Somatic mutation testing for metastatic colorectal cancer	**NCCN** guidelines for colorectal cancer	• Claim for MSI, MMR IHC, KRAS, NRAS or BRAF in the two months prior to diagnosis through six months after diagnosis	• Age 18+ • Colorectal cancer • First or only cancer • Includes AJCC stage IV or SEER stage distant • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through six months following diagnosis	Start: Two months prior to diagnosis End: Six months after diagnosis

* See page 32 for definitions of HICOR Treatment Period and HICOR Follow-up Period

Appendix A: Individual Metric Definitions

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 1: Recommended Cancer Treatment (Cost)				
Total cost during treatment		• All amounts paid by insurers to health care providers during HICOR Treatment Period*	Measure 1A: Patients eligible for any Recommended Treatment for Breast, Colorectal and Non-Small Cell Lung Cancer quality metrics Measure 1B: Patients eligible for any Recommended Treatment for Breast Cancer quality metrics	HICOR Treatment Period*

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 2: Hospitalization During Chemotherapy (Summary Quality Score)				
Emergency department (ED) visits during chemotherapy	**OCM**-2	• ED claim without subsequent inpatient admission (≤1 day) within 180 days of first chemotherapy claim	• Age 18+ • All cancers except leukemia • First or only cancer • Medical coverage in month of diagnosis and for six months from first chemotherapy claim (or until death) • Claim for outpatient chemotherapy within 180 days of diagnosis • No bone marrow transplant between diagnosis and 180 days after first outpatient chemotherapy	Start: First outpatient chemotherapy End: Start date + 180 days
Inpatient (IP) stays during chemotherapy	**OCM**-1	• Hospital IP admission not related to a cancer-directed surgery within 180 days of first chemotherapy claim	• Age 18+ • All cancers except leukemia • First or only cancer • Medical coverage in month of diagnosis and for six months from first chemotherapy claim (or until death) • Claim for outpatient chemotherapy within 180 days of diagnosis • No bone marrow transplant between diagnosis and 180 days after first outpatient chemotherapy	Start: First outpatient chemotherapy End: Start date + 180 days
Measure 2: Hospitalization During Chemotherapy (Cost)				
Total cost within six months of initial chemotherapy		All amounts paid by insurers to health care providers from first outpatient chemotherapy through 180 days	Patients eligible for Hospitalization During Chemotherapy quality measure	Start: First outpatient chemotherapy End: Start date + 180 days

Definition of Chemotherapy:

Chemotherapy utilization is measured using administrative and drug procedure codes. Chemotherapy includes traditional chemotherapy, immunotherapy and biologics. The drugs could be delivered either through an IV or orally. Chemotherapy does not include hormone therapy (e.g., tamoxifen) or supportive care (e.g., colony-stimulating factors).

* See page 32 for definitions of HICOR Treatment Period and HICOR Follow-up Period

Appendix A: Individual Metric Definitions

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 3: Breast Cancer Tumor Marker Testing Following Treatment (Summary Quality Score)				
Breast cancer tumor marker testing following treatment	**QOPI** BR62c1 & BR62c2	• Claim for tumor marker test (CEA, CA 15-3, CA 27.29) during HICOR Follow-up Period*	• Age 18+ • Female • Breast cancer • First and only cancer • AJCC stage I, II, IIIA • Received curative treatment (mastectomy, or lumpectomy plus radiation within 90 days) • Medical coverage from diagnosis through end of follow-up period*	HICOR Follow-up Period*
Measure 3: Breast Cancer Tumor Marker Testing Following Treatment (Cost)				
Total cost during follow-up period		All amounts paid by insurers to health care providers during HICOR Follow-up Period*	Patients eligible for Breast Cancer Tumor Marker Testing Following Treatment quality metric	HICOR Follow-up Period*

* See page 32 for definitions of HICOR Treatment Period and HICOR Follow-up Period

Appendix A: Individual Metric Definitions

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 4: End-of-Life Care (Summary Quality Score)				
Chemotherapy in the last 14 days of life	**MACRA** #453 **QOPI** EOL48 **NQF** #0210	• Claim for any chemotherapy in the last 14 days of life	• Age 18+ • Patient died • Solid tumors only (excludes leukemia, lymphoma and myeloma) • Includes AJCC stage II/III/IV or SEER stage regional/distant • Medical coverage six months prior to death through date of death	Last 180 days of life
Multiple Emergency Department (ED) visits in the last 30 days of life	**MACRA** #454 **QOPI** EOL49 **NQF** #0211	• More than one ED visit in the last 30 days of life	• Age 18+ • Patient died • Solid tumors only (excludes leukemia, lymphoma and myeloma) • Includes AJCC stage II/III/IV or SEER stage regional/distant • Medical coverage six months prior to death through date of death	Last 180 days of life
Intensive Care Unit (ICU) stay in the last 30 days of life	**MACRA** #455 **QOPI** EOL49a **NQF** #0213	• Hospital ICU admission for any reason in the last 30 days of life	• Age 18+ • Patient died • Solid tumors only (excludes leukemia, lymphoma and myeloma) • Includes AJCC stage II/III/IV or SEER stage regional/distant • Medical coverage six months prior to death through date of death	Last 180 days of life
Hospice care three or more days prior to death	**MACRA** #457 **OCM**-3 **QOPI** EOL44 **NQF** #0216	• Two or more inpatient or outpatient hospice claims, with the first claim at least three days prior to death	• Ages 18+ • Patient died • Solid tumors only (excludes leukemia, lymphoma and myeloma) • Includes AJCC stage II/III/IV or SEER stage regional/distant • Medical coverage six months prior to death through date of death	Last 180 days of life
Measure 4: End-of-Life Care (Cost)				
Total cost in last 30 days of life		All amounts paid by insurers to health care providers in last 30 days of life	Patients eligible for any End-of-Life Care quality metrics	Last 180 days of life

Definitions of HICOR Care Periods

TREATMENT PERIOD:

Start: First treatment. Treatment is defined as surgery, chemotherapy or radiation therapy.
End: Earliest of:

1. 12 months following first treatment, or
2. Start of follow-up period. The follow-up period begins at the start of a four-month gap in treatment (i.e., surgery, chemotherapy or radiation therapy).

FOLLOW-UP PERIOD:

Start: Beginning of a four-month gap in treatment. Treatment is defined as surgery, chemotherapy or radiation therapy.
End: Earliest of:

1. 13 months following start of follow-up period, or
2. Start of new treatment (i.e., surgery, chemotherapy or radiation therapy).

Appendix A: Individual Metric Definitions

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 5: Germline Testing (State-Level Reporting)				
Germline testing for breast cancer	**NCCN** guidelines for Genetic/ Familial High-Risk Assessment: Breast, Ovarian and Pancreatic	• Claim for BRCA1/2 test in the two months prior to diagnosis through 24 months after diagnosis	• Age 18+ • Breast cancer • First or only cancer • Group recommended for germline testing: triple negative, male or age under 50 • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through 24 months following diagnosis	N/A
Germline testing for ovarian cancer	**NCCN** guidelines for Genetic/ Familial High-Risk Assessment: Breast, Ovarian and Pancreatic	• Claim for germline test in the two months prior to diagnosis through 24 months after diagnosis	• Age 18+ • Ovarian, fallopian tube or peritoneum cancer • First or only cancer • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through 24 months following diagnosis	N/A
Germline testing for pancreatic cancer	**NCCN** guidelines for Genetic/ Familial High-Risk Assessment: Breast, Ovarian, and Pancreatic	• Claim for germline test in the two months prior to diagnosis through 24 months after diagnosis	• Age 18+ • Adenocarcinoma of the pancreas • First or only cancer • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through 24 months following diagnosis	N/A
Germline testing for prostate cancer	**NCCN** guidelines for Prostate Cancer	• Claim for germline test in the two months prior to diagnosis through 24 months after diagnosis	• Age 18+ • Prostate cancer • First or only cancer • Stage: metastatic, regional (node positive) or high- or very-high-risk localized (see NCCN guidelines for Prostate Cancer) • Alive three months after diagnosis • Medical coverage two months prior to diagnosis through 24 months following diagnosis	N/A

HICOR METRIC	SOURCE	NUMERATOR	DENOMINATOR	CLINIC ATTRIBUTION PERIOD
Measure 6: Timeliness of Care (State-Level Reporting)				
Time to start of treatment		Median number of days between first visit at an oncology clinic (no more than 30 days prior to diagnosis) and first treatment (radiation or chemotherapy) If the patient visited multiple oncology clinics, the clinic with the greatest number of visits was selected	• Age 18+ • Solid tumors only (excludes leukemia, lymphoma and myeloma) • First or only cancer • Includes AJCC stage IV or SEER stage distant • First treatment was radiation or chemotherapy • Treatment started within 12 months of diagnosis • Medical coverage one month prior to diagnosis through 12 months following diagnosis	N/A

Appendix B: Patient Attribution to Clinics

For each measure, HICOR attributes patients to one clinic. The principle behind this methodology is to capture the clinic most likely to be directing the patient's cancer care during the measure's period of interest. Clinics are identified using Tax ID Numbers (TINs) or CMS Certification Numbers (CCNs) on health insurance claims. Specific clinic's TINs and CCNs are available upon request. Similar to OCM's patient attribution methodology, we prioritize claims for physician encounters by attributing episodes to the clinic associated with the most Evaluation & Management (E&M) visits with a cancer diagnosis during the period of interest. HICOR's patient attribution also adopts MACRA's episode attribution methodology, using similar E&M visit and claim exclusion criteria methodology.

Steps in Assigning Patients to Clinics

1. Identify the relevant time period used to assign patients to clinics. Time periods are dependent on the metric and are listed in the Individual Metric Definitions.
2. Find appropriate cancer-related paid claims (ICD-9 diagnosis codes 140-209, 230-234, 273.3; ICD-10 diagnosis codes C00-D09, D46) for the time period of interest. Exclude the following claims:
   - Durable Medical Equipment claims and Prescription Drug Event claims in the Medicare data
   - Claims from diagnostic (e.g., labs, imaging and pathology) and hospice centers
   - Claims from ambulance services
   - Claims from physician groups that service multiple clinics
3. Using the claims identified in step 2, assign each patient a clinic:
   - First pass: Use Evaluation & Management codes to identify the provider guiding care (CPT 99201-99205, 99211-99215, 99217-99239, 99241-99255, 99354-99359, 99374-99380 and 99441-99444)
   - If the first pass does not identify a provider, do a second pass on all claims after removing all but the first radiation oncology claim (CPT codes 77261-77799 and 77014)
4. Add clinic group based on Tax ID Number (TIN) or CMS Certification Number (CCN).

Note: TINs are available in commercial claims and Medicare Part B Carrier claims. CCNs are available in Medicare Inpatient, Outpatient, Skilled Nursing Facility, Home Health and Hospice claims.

5. Count the number of claims for each clinic group.

6. Select the clinic group with the highest count for each patient. If there is a tie, select the clinic that has claim(s) closest to the index date. Index dates (e.g., diagnosis date, first surgery date) are chosen specifically for each metric.

A note on clinic ownership change: Patients attributed to a clinic whose ownership changed before Jan. 1, 2021, are attributed to the new owner's clinic group. Clinics with an ownership change after Jan. 1, 2021, are identified as separate clinics. Clinics with an ownership change that continue to operate separately (maintained separate TINs and CCNs) are left as separate clinics in the results.

Appendix C: Calculating Summary Quality Score and Cost

HICOR uses a variety of recognized methods for measuring performance and cost, including methods to account for differences in the numbers of patients per clinic, patient characteristics and outliers in the data. The methods include calculating risk-standardized rates, combining individual quality metrics into a quality score and calculating risk-standardized average episode costs per patient based on claims paid by the health insurer to the clinic.

Quality Metrics: Calculating Risk-Standardized Rates

HICOR generates clinic-level risk-standardized rates for each individual quality metric using a Hierarchical Generalized Linear (HGLM) statistical model with a binary distribution and a logit link function. Each clinic's risk-standardized rate is calculated as the ratio of the clinic's predicted rate to the clinic's expected rate multiplied by the regional rate (as shown in the box on the right). The Centers for Medicare and Medicaid Services use the HGLM model to report hospital outcomes, as do numerous other organizations involved in performance reporting.[1, 2] The HGLM model accounts for the fact that patients are clustered within clinics in order to generate more accurate estimates of clinic quality. The model also accounts for differences in the number of patients per clinic by shrinking observed outcomes toward the regional average based on how reliable the outcome is. For clinics with large numbers of patients, outcomes tend to be measured more reliably and have less shrinkage toward the regional average. However, larger clinics also have a larger impact on the regional average. On the other hand, the outcomes for clinics with fewer patients tend to be less reliable and have more shrinkage, but these clinics also have a smaller impact on the regional average.

The HGLM model includes clinic-level random intercept variables as measures of a clinic's quality of care along with patient-level risk adjustors, when appropriate (see Appendix D). Random intercepts are a specific type of variable that are inferred mathematically from a statistical model using other directly observable data (e.g., outcomes, patient characteristics). The clinic's predicted and expected rates are determined from the HGLM model and include the clinic's predicted number of outcomes based on its patient mix. However, the clinic's predicted rate also includes its predicted random intercept, while the clinic's expected rate can be obtained by averaging the clinic's predicted rates over the distribution of clinic-level random intercepts. When lower outcomes are better, as in the case of the Hospitalization During Chemotherapy metrics, a (predicted/expected) ratio < 1 indicates that the clinic is performing better than expected given its patient mix, while a (predicted/expected) > 1 indicates that the clinic is performing worse than expected. When higher outcomes are better, as in the case of Treatment metrics, a (predicted/expected) < 1 indicates that the clinic is performing worse than expected. Note that we employed a slight statistical correction to the calculation of the expected rate in the case of tumor markers to account for the large skew in the unadjusted clinic rates.

$$\text{Clinic-level risk-standardized rate} = \left(\frac{\text{Predicted rate}}{\text{Expected rate}}\right) \times \text{Observed regional average}$$

Clinic's predicted rate = Clinic-level random intercept + predicted outcomes based on the clinic's patient mix

Clinic's expected rate = Average of the clinic's predicted rates

Quality Score: Combining the Quality Metrics

A quality score is often included in quality measurement[3] because it summarizes a clinic's overall performance and can provide a broader assessment of quality of care. Quality scores can also improve statistical reliability,

Appendix C: Calculating Summary Quality Score and Cost

partly through increasing the numbers of patients, and have been shown to more accurately predict future hospital performance compared with a single risk-adjusted outcome measure.[4] There is no standard way to calculate a quality score.[5] HICOR's approach compares the clinic's risk-standardized rate to the regional average for each metric. If a low score indicates higher quality, we subtract the regional average from the clinic's risk-standardized rate. In this case, a risk-standardized rate that is lower than the regional average indicates that the clinic performed better than the regional average. If a high score indicates higher quality, we subtract the clinic's risk-standardized rate from the regional average. In this case, a risk-standardized rate that is higher than the regional average indicates that the clinic performed better than the regional average.

A clinic's quality score is the sum of the above differences between the risk-standardized rate and the regional average for each quality metric in the measure (e.g., End of Life, Appropriate Treatment). For example, for the End-of-Life Care quality score, we combine the clinic's performance on each of the individual metrics — Chemotherapy in the last 14 days of life, Multiple Emergency department (ED) visits in the last 30 days of life, Intensive care unit (ICU) stay in the last 30 days of life and Hospice care three or more days before death — into a single quality score. See the box to the right.

As shown in the example in the table below, a quality score of 0% may reflect that the clinic performed at the regional average for both metrics, or that it performed better than the regional average for one metric and equivalently worse than the regional average for the other metric (Clinic C). A quality score above 0% may reflect that a clinic performed better than the regional average for both metrics (Clinic A), or that it performed better than the regional average for one metric and worse than the regional average for the other metric, but there was a smaller difference for the second metric (Clinic B). A quality score below 0% has the opposite explanation (Clinic D).

If low score = higher quality, subtract regional average from clinic risk-standardized rate

If high score = higher quality, subtract clinic risk-standardized rate from regional average

Clinic's quality score = sum of above differences for each quality metric in the measure

We chose this quality score because the ranges of the risk-standardized rates (e.g., the highest minus the lowest) can vary considerably across the metrics in the same measure. Some metrics had smaller and possibly less meaningful differences in quality across clinics, while others had larger and possibly more meaningful differences. For example, in the End-of-Life Care measure published in the 2023 report, we found that the range for Chemotherapy in the Last 14 Days of Life was 7.1% (10.9% – 3.8%), while the range for ICU Stay in the Last 30 Days of Life was 27.4% (40.9% – 13.5%). In the case of

Example: How to Calculate a Summary Quality Score from Two Metrics

	Metrics Where Low Scores = Higher Quality (e.g., Multiple ED Visits)		Metrics Where High Scores = Higher Quality (e.g., Hospice Use)		Measure (e.g., End of Life)
	Risk-Standardized Rates (RSR)	Region Average – RSR	Risk-Standardized Rates (RSR)	Region Average – RSR	SUMMARY QUALITY SCORE
Clinic A	4%	1%	11%	7%	8%
Clinic B	6%	-1%	9%	5%	4%
Clinic C	7%	-2%	6%	2%	0%
Clinic D	10%	-5%	3%	-1%	-6%
	Regional Average = 5%		Regional Average = 4%		

Appendix C: Calculating Summary Quality Score and Cost

Chemotherapy in the last 14 days of life, no clinic received a large difference (Regional Average – Risk-Standardized Rate) toward its summary quality score, reflecting that this measure had a relatively smaller difference in outcomes. However, in the case of ICU care, the clinics that performed either far above or far below the regional average received a larger difference (Risk-Standardized Rate – Regional Average) toward their summary quality score, reflecting that this measure had a larger difference in outcomes.

Given our community public reporting perspective, we use a different quality score than the one used in the Oncology Care Model (OCM).[6] In the OCM, each clinic receives between 0 and 10 points for each metric, based on the rankings of its risk-standardized rates compared to its peers. However, the OCM demonstration program includes over 190 clinics. The program uses only quality metrics with sufficiently large variation in outcomes and its quality score includes more metrics. In the national context, these features help ensure that differences in the points correspond to meaningful differences in clinic quality. In contrast, this report has at most 29 clinics per metric, and fewer metrics in our quality scores. We also report the outcomes of all metrics, regardless of the range in risk-standardized rates, to provide information on where meaningful differences in quality may exist in our state. Applying the OCM's scoring system would not account for the variation in the range of outcomes we found.

Costs: Calculating Risk-Standardized Average Episode Costs per Patient

To calculate costs, we determine an average per-patient cost for the episodes associated with a measure. All of the measures, except Measure 1 (Recommended Cancer Treatment) have the same population in each quality metric and the costs. For Measure 1, we include the costs of all patients in the different metrics.

Costs include all reimbursements paid by the health insurers during the episode, which may include non-cancer costs. We adjust costs for inflation to 2023 using the annual average Consumer Price Index. We also account for outliers by winsorizing costs at the 5th and 95th percentiles by cancer type and metric where applicable. Winsorizing sets all costs below the 5th percentile to the level of the costs at the 5th percentile and all costs above the 95th percentile to the level of costs at the 95th percentile.[6] We then use an HGLM model with a log link and gamma distribution, because it accounts for the skewed distribution of costs and yields only positive predictive values.

All costs are risk adjusted (see Appendix D). Each clinic's risk-standardized average episode cost per patient is the ratio of the clinic's predicted costs to the clinic's expected costs multiplied by the regional average costs (similar to the calculation of the risk-standardized rates for the quality metrics). Due to our aim of community public reporting, our approach to calculating costs is different from MACRA[7] and the OCM,[6] including different risk adjustors and the fact we do not benchmark costs to previous years.

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7. Centers for Medicare and Medicaid Services. Oncology Care Model. https://innovation.cms.gov/innovation-models/oncology-care

Appendix D: Risk Adjustment

Risk, severity or case-mix adjustment refers to the statistical process used to adjust for differences among clinic patient populations. The goal of risk adjustment is to account for patient factors that are present before the period when the outcome is measured that may influence the outcome in ways unrelated to the quality of care provided by the clinic. Risk adjustment helps facilitate a "level playing field" when comparing the outcomes achieved by different clinics.[1]

Developing the Risk Adjustment Models

HICOR's process of developing risk adjustment models is guided by the CMS Measure Management System[1] and the NQF's Measure Developer Guidebook[2] but is tailored to our goal of community public reporting.

Our metrics fall into two types: 1) process metrics (e.g., Recommended Treatment), which capture whether the right care was given to the right patient at the right time and tend to be a narrower indicator of quality, and 2) outcome metrics (e.g., Hospitalization During Chemotherapy), which are aggregate markers of quality, combining numerous factors that may be difficult to measure individually.[3] All outcome metrics and costs are risk adjusted, and process measures are adjusted for cancer type only.

For each metric, we developed a list of potential patient-level clinical and demographic risk adjustors based on 1) literature review, 2) variables available in our data source (e.g., cancer registry variables), 3) expert clinical opinion, and 4) empirical analysis. A partial list is included on this page and the next. Given the small size of our community population, we developed parsimonious risk adjustment models by including a strictly limited number of risk adjustors to avoid the problem of overfitting (e.g., a risk adjustment model performs well in one population but poorly in another). Following current performance methodology best practices, we removed non-significant variables (excluding age and sex) from the risk adjustment model by combining stepwise purposeful selection, assessing the degree of multicollinearity between variables, and removing predictors that offered little improvement in overall model fit. Following recently amended NQF guidance on risk adjusting for sociodemographic factors, we also explored three proxies for socioeconomic status: census tract-level median income, dual eligibility for Medicare and Medicaid, and non-Hispanic White vs. Others for race. Given the demographics of our region, race was not significant and was removed from the final models.

List of Risk Adjustors

Below is a brief overview of the risk adjustors used in this report. The table at the end of this appendix lists the risk adjustors that are used in the models.

- Age: Age of the patient at the time of diagnosis, calculated using the cancer registry's dates of birth and diagnosis. All outcome and cost models include either this variable or age interacted with insurance status (e.g., Medicare × Age, Commercial × Age) when we need to control for differences in coverage policies and reimbursement rates among different insurers.
- Sex: Sex as reported by the cancer registry.
- Charlson Score (0, 1, 2+): A weighted score reporting non-cancer comorbidities. The Charlson Score uses claims data and was originally developed to predict the risk of death within one year of hospitalization by identifying specific comorbid conditions, such as heart disease or diabetes.[4] However, it has emerged as one of the most widely recognized predictors of health care outcomes and expenditures. We categorize the scores into three groups: 0, 1 and 2 or above.
- Area Deprivation Index (ADI) is a measure of a patient's neighborhood socioeconomic disadvantage or the material deprivation in a person's residence at the census tract level. It includes 17 factors such as income and income disparity, education,

Appendix D: Risk Adjustment

employment, and housing costs and quality. ADI ranges from 1 (least deprived) to 10 (most deprived).[5] Census tract information is reported by the cancer registry, and ADI is based on the 2014-2018 American Community Survey 5-Year Estimates.[6]

- Medicare Indicator: Measures whether a patient had Medicare insurance at any point during the period of interest. This variable is included to control for differences in coverage policies and reimbursement rates among different insurers.
- Medicare × Age: Due to the correlation between age and enrollment in Medicare, this variable allows for both Medicare and Age to be included in the model.
- Medicare × Dual Eligibility: Dual Eligibility indicates whether a Medicare patient is enrolled in both Medicaid and Medicare during the period of interest. All dual-eligible patients are Medicare enrollees, so this variable allows for both Medicare and Dual Eligibility to be included in the model.
- Commercial Insurance: Measures whether a patient had only commercial insurance during the period of interest. This variable is included to control for differences in coverage policies and reimbursement among different insurers. This indicator is used in models where it is a better statistical fit than the Medicare indicator. In general, this indicator is a better fit for populations that are younger and have a larger proportion of commercial insurance enrollees.
- Commercial Insurance × Age: Due to the correlation between age and enrollment in a commercial plan, this variable allows for both the Commercial indicator and Age to be included in the model.
- AJCC Stage: The American Joint Committee on Cancer (AJCC) stage of the patient's tumor at the time of diagnosis, as reported by the cancer registry. AJCC stages range from in situ to stage I through IV to unknown stage.
- Cancer Site (Cancer Indicators: Breast, Colorectal, Lung, Prostate, Gynecologic, Bladder, Melanoma, Myeloma, Oral, Kidney, Liquid Tumor): These variables indicate the type of cancer a patient is diagnosed with, as reported by the cancer registry.
- # Days in the Period: The number of days the patient was in the period of interest.
- # Chemo Administrations: The number of days with a claim for chemotherapy administration or drug during the period of interest.
- Radiation Receipt Indicator: An indicator for patient receipt of any radiation treatment during the period of interest, as identified using claims data.
- Surgery Receipt Indicator: An indicator for patient receipt of cancer-directed surgeries during the period of interest, as identified using claims data. The list of surgeries is pulled from the OCM[7] and in-house clinical expertise.

Limitations of Risk Adjustment

Risk adjustment cannot account for all patient-level factors that influence outcomes but are outside of the cancer clinics' control. The Measure Limitations section for each measure describes limitations in risk adjustment for that particular measure.

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Appendix D: Risk Adjustment

	TREATMENT						
	Measure 1A: Recommended Treatment for Breast, Colorectal and Lung Cancer		Measure 1B: Recommended Treatment for Breast Cancer		Measure 2: Hospitalization During Chemotherapy		
Individual Metrics	Recommended Therapy	Cost	Recommended Therapy Based on ER/PR & HER2 Status	Cost	ED During Chemo	IP During Chemo	Cost
Risk Adjustors							
Age (continuous)		X		X			X
Sex					X		X
Race							
Charlson Score (0, 1, 2+)[1]					X	X	X
Area Deprivation Index (ADI)[2]				X	X		
Medicare Indicator		X		X			X
Medicare × Age		X					X
Medicare × Dual Eligibility					X		X
AJCC Stage					X	X	X
Breast Cancer Indicator					X	X	
Colorectal Cancer Indicator	X				X	X	X
Lung Cancer Indicator	X	X					X
Prostate Cancer Indicator					X	X	X
Gynecologic Cancer Indicator							X
Bladder Cancer Indicator							X
Melanoma Cancer Indicator							X
Pancreatic Cancer Indicator							X
Kidney Cancer Indicator							X
LIver Cancer Indicator							X
Liquid Tumor Indicator						X	X
# Days in Period		X		X		X	X
# Chemo Administrations							X
Radiation Receipt Indicator							X
Surgery Receipt Indicator					X	X	X

1. Reference Appendix D for Charlson Score
2. Reference Appendix D for Area Deprivation Index (ADI)

Appendix D: Risk Adjustment

	FOLLOW-UP		END OF LIFE			
	Measure 3: Breast Cancer Tumor Marker Testing Following Treatment		Measure 4: End-of-Life Care			
Individual Metrics	BC Tumor Marker	Cost	Chemo in Last 14 Days & Hospice	Multiple ED in Last 30 Days	ICU in Last 30 Days	Cost
Risk Adjustors						
Age (continuous)		X		X	X	X
Sex					X	
Race		X		X		
Charlson Score (0, 1, 2+)[1]		X		X	X	X
Area Deprivation Index (ADI)[2]		X		X		X
Medicare Indicator		X				X
Medicare × Age		X				X
Medicare × Dual Eligibility		X				X
AJCC Stage		X			X	X
Breast Cancer Indicator						
Colorectal Cancer Indicator				X		
Lung Cancer Indicator					X	
Prostate Cancer Indicator						X
Gynecologic Cancer Indicator						
Bladder Cancer Indicator						
Melanoma Cancer Indicator						
Pancreatic Cancer Indicator						
Kidney Cancer Indicator						
Liver Cancer Indicator						
Liquid Tumor Indicator						
# Days in Period						
# Chemo Administrations						
Radiation Receipt Indicator						
Surgery Receipt Indicator						

1. Reference Appendix D for Charlson Score
2. Reference Appendix D for Area Deprivation Index (ADI)

Appendix E: Acronyms

ABIM	American Board of Internal Medicine
ADI	Area Deprivation Index
AJCC	American Joint Committee on Cancer
ALK	Anaplastic Lymphoma Kinase
ASCO	American Society of Clinical Oncology
BRAF	V-Raf Murine Sarcoma Viral Oncogene Homolog B
BRCA 1/2	Breast Cancer Gene
CA 15-3	Cancer Antigen 15-3
CCN	CMS Certification Number
CEA	Carcinoembryonic Antigen
CMS	Centers for Medicare & Medicaid Services
CPT	Current Procedural Terminology
CSS	Western Washington Cancer Surveillance System
E&M	Evaluation & Management
ED	Emergency Department
EGFR	Epidermal Growth Factor Receptor
EOL	End of Life
ER	Estrogen Receptor
HER2	Human Epidermal Growth Factor Receptor 2
HCC	Hierarchical Condition Categories
HGLM	Hierarchical Generalized Linear Model
HICOR	Hutchinson Institute for Cancer Outcomes Research
ICD	International Classification of Diseases
ICU	Intensive Care Unit
IP	Inpatient
KRAS	Kirsten Rat Sarcoma Virus
MACRA	Medicare Access and CHIP Reauthorization Act of 2015
MMR IHC	Mismatch Repair Immunohistochemistry
MSI	Microsatellite Instability
NCCN	National Comprehensive Cancer Network
NCQA	National Committee for Quality Assurance
NGS	Next-Generation Sequencing
NQF	National Quality Forum
NRAS	Neuroblastoma RAS viral oncogene homolog
NSCLC	Non-Small Cell Lung Cancer
OCM	Oncology Care Model
PQRS	Physician Quality Reporting System
PR	Progesterone Receptor
QOPI	Quality Oncology Practice Initiative
ROS1	ROS Proto-Oncogene1, Receptor Tyrosine Kinase
SEER	Surveillance, Epidemiology and End Results
TIN	Tax Identification Number
VCC	Value in Cancer Care
WSCR	Washington State Cancer Registry

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