ONCOLOGY CARE MODEL

OCM PREDICTION MODEL

Used in Benchmark Pricing

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Introduction

Under the Oncology Care Model (OCM), actual episode expenditures will be compared to target expenditures for each participating practice or pool. If actual expenditures are less than target expenditures for a given performance period, the difference forms the basis for any performance-based payments due to the practice or pool. Target expenditures are a projection of what Medicare expenditures would have been during the performance period for episodes attributed to the OCM practice or pool in the absence of OCM participation, reduced for the OCM discount. The first step in calculating target expenditures is to calculate a risk-adjusted predicted price for each episode, based on 3 years of historical data. We do this using a generalized linear model with a log link and gamma distribution. This type of model is commonly used in predicting health care expenditures and yields only positive predicted values. Predicted prices are derived from the model as:

$PE_i = \exp(X_i\beta)$, where

PE_i = Predicted expenditures of the ith episode
X_i = Characteristics of the ith episode (e.g., age, sex, cancer type, etc.)
β = Vector of coefficients from the prediction model based on episodes attributed to all practices (participating and not participating in OCM) in the3-year baseline period

The model predicts total standardized Medicare expenditures for a 6-month episode, winsorized at the 5% and 95% levels of episode expenditures within cancer type. An experience adjuster is then applied to the predicted prices to reflect the specific cost experience of the practice or pool during the baseline period. Details of the performance-based payment methodology, including the benchmarking method, expenditure definition, and form of the prediction pricing model, are described in the document "OCM PBP Methodology," which is available on the OCM Portal.

The purpose of this document is to describe the definition and form of the covariates that are incorporated into the OCM prediction model. The covariates are listed below and are described in more detail in the subsequent sections. Some covariates may be refined over the course of OCM to improve the accuracy of the prediction model.

OCM Prediction Model Covariates:

1. Age/Sex
2. Cancer type
3. Chemotherapy drugs taken/administered during the episode (breast cancer only)
4. Receipt of cancer-related surgery
5. Part D eligibility and dual eligibility for Medicare and Medicaid
6. Receipt of radiation therapy
7. Receipt of bone marrow transplant
8. Clinical trial participation
9. Comorbidities

10. History of prior chemotherapy use
11. Institutional status
12. Episode length
13. Geographic location/Hospital Referral Region

These covariates are summarized with brief descriptions in Table 1 at the end of this document. Covariates that serve as reference groups in the prediction model are noted.

1. Age and Sex

Age is calculated as of the first day of the episode. Ten age/sex categories are included in the model:

FEMALE_AGE_18_64	MALE_AGE_18_64
FEMALE_AGE_65_69 (reference group)	MALE_AGE_65_69
FEMALE_AGE_70_74	MALE_AGE_70_74
FEMALE_AGE_75_79	MALE_AGE_75_79
FEMALE_AGE_80+	MALE_AGE_80+

2. Cancer Type

There are 21 cancer types eligible for reconciliation, defined by specific diagnosis codes. The reconciliation-eligible cancer types are:

Acute Leukemia	Kidney Cancer
Anal Cancer	Liver Cancer
Bladder Cancer	Lung Cancer
Breast Cancer	Lymphoma
Chronic Leukemia	Malignant Melanoma
Central Nervous System (CNS) Tumor	Multiple Myeloma
Endocrine Tumor	Myelodysplastic Syndrome (MDS)
Female Genitourinary (GU) Cancer other than Ovarian	Ovarian Cancer
Gastro/Esophageal Cancer	Pancreatic Cancer
Head and Neck Cancer	Prostate Cancer
Intestinal Cancer	

Specific variable names are provided in Section 4 below. Information on the specific diagnosis codes that correspond to each of the reconciliation-eligible cancer types and how a cancer type is assigned to an episode is included in the document "OCM PBP Methodology," which is available on the OCM Portal.

3. Chemotherapy Drugs Taken/Administered During the Episode (Breast Cancer Only)

An additional consideration applies to breast cancer episodes. Many breast cancer episodes represent women who are on long-term oral endocrine therapy such as tamoxifen or an aromatase inhibitor. These drug therapies are covered under Medicare Part D. Breast cancer episodes involving only Part D chemotherapy (i.e., no Part B chemotherapy) tend to be much less costly than breast cancer episodes that include at least some chemotherapy covered under Part B. Therefore, the OCM prediction model distinguishes breast cancer episodes containing only Part D chemotherapy from those containing some Part B chemotherapy. Specific variable names for these covariates are provided in Section 4 below.

4. Receipt of Cancer-Related Surgery

Twelve of the cancer types have cancer-related surgeries that are controlled for in the OCM prediction model if the surgeries occur during an episode. The specific surgeries are listed in the document "OCM Prediction Model Code Lists," which is available on the OCM portal, and are different for each cancer type. Each of the twelve cancer types with cancer-related surgeries is represented by two variables in the model: one for episodes in which a cancer-related surgery was performed and one for episodes in which no cancer-related surgery was performed. Each cancer type that does not have a specific surgery adjustment is represented by a single variable in the model.

For breast cancer, the model also distinguishes surgery based on the Part D chemotherapy distinction described in Section 3 above. This results in four variables for breast cancer episodes: Only Part D chemotherapy with surgery; Only Part D chemotherapy without surgery; Part B chemotherapy with surgery; Part B chemotherapy without surgery.

The variables representing cancer types, surgery, and Part D only chemotherapy are summarized below:

Breast cancer

BREAST_PART_D_ONLY_WITH_SURGERY
BREAST_PART_D_ONLY_WITHOUT_SURGERY (reference group)
BREAST_PART_B_WITH_SURGERY
BREAST_PART_B_WITHOUT_SURGERY

Other cancer types with cancer-related surgeries

ANAL_WITH_SURGERY
BLADDER_WITH_SURGERY
FEMALE_GU_WITH_SURGERY
GASTRO_WITH_SURGERY
ANAL_WITHOUT_SURGERY
BLADDER_WITHOUT_SURGERY
FEMALE_GU_WITHOUT_SURGERY
GASTRO_WITHOUT_SURGERY

HEAD_NECK_WITH_SURGERY	HEAD_NECK_WITHOUT_SURGERY
INTESTINAL_WITH_SURGERY	INTESTINAL_WITHOUT_SURGERY
LIVER_WITH_SURGERY	LIVER_WITHOUT_SURGERY
LUNG_WITH_SURGERY	LUNG_WITHOUT_SURGERY
OVARY_WITH_SURGERY	OVARY_WITHOUT_SURGERY
PANCREAS_WITH_SURGERY	PANCREAS_WITHOUT_SURGERY
PROSTATE_WITH_SURGERY	PROSTATE_WITHOUT_SURGERY

Cancer Types without cancer-related surgeries

ACUTE_LEUKEMIA	CHRONIC_LEUKEMIA	CNS
ENDOCRINE	KIDNEY	LYMPHOMA
MDS	MELANOMA	MYELOMA

5. Part D Eligibility and Dual Eligibility for Medicare and Medicaid

Dual eligibility refers to beneficiaries who are enrolled in both Medicare and Medicaid. Full dual eligibility refers to eligibility for full Medicaid benefits; these beneficiaries are normally entitled to Part D enrollment with a low income subsidy (LIS). Beneficiaries with partial Medicaid benefits and other low income beneficiaries without Medicaid may also qualify for Part D and the LIS. The following set of variables defines eligibility for full Medicaid benefits and Part D (measured at the beginning of the episode) in the OCM prediction model:

FULL_DUAL – Has full Medicaid benefits (including Part D and LIS)
PART_D_LIS – Does not have full Medicaid benefits but does have Part D with LIS
PART_D_NO_LIS – Has Part D enrollment but no LIS
NO_PART_D – Has no Part D enrollment (reference group)

These categories are mutually exclusive and exhaustive.

6. Receipt of Radiation Therapy

A single variable indicates whether radiation therapy was provided during the episode or not. The ICD 9 and HCPCS procedure codes used to identify radiation therapy are contained in the document "OCM Prediction Model Code Lists," which is available on the OCM Portal. The codes are restricted to those indicating the delivery of radiation therapy, and do not include planning or preparation for radiation therapy. If any claim during an episode had one of the procedure codes listed for radiation delivery, the RADIATION variable was assigned a value of 1 (otherwise 0).

7. Receipt of Bone Marrow Transplant

Two bone marrow transplant (BMT) variables are calculated: one for allogeneic BMTs (BMT_ALLOGENEIC) and one for autologous BMTs (BMT_AUTOLOGOUS). BMTs will be counted for

four cancer types: Acute Leukemia, Lymphoma, Multiple Myeloma, and MDS. If both types of BMT appear in a given episode, the allogeneic BMT will take precedence. BMT procedures are identified by the codes included in the document "OCM Prediction Model Code Lists," which is available on the OCM Portal. The claim with the BMT procedure code or DRG must contain a diagnosis code for the same cancer type as the episode.

8. Clinical Trial Participation

A single variable (CLINICAL_TRIAL) indicates whether the beneficiary participated in a cancer clinical trial during the episode. An ICD 9 diagnosis code of V70.7 must appear on a claim that also contains a cancer diagnosis and has a service date within the 6-month episode.

9. Comorbidities

Comorbidities are measured through a subset of the CMS Hierarchical Condition Category (HCC) flags. These flags are created by CMS on a calendar year basis and indicate treatment for 70 different conditions in the prior calendar year. The number of HCC flags that are "turned on" in the calendar year in which the episode started is incorporated in the model because episode expenditures increase with higher numbers of pre-existing comorbidities. Condition flags related to cancer are not counted in the OCM prediction model because all beneficiaries in OCM episodes have cancer. Also, flags associated with opportunistic infections, protein-calorie malnutrition, severe hematological disorders, disorders of immunity, and coagulation defects and other specified hematological disorders are not counted because these conditions are often preventable or are a recognized aspect of the specified cancer, and are therefore already incorporated into baseline episode expenditures. The HCC-related variables are as follows:

HCC_0 – No HCC flags turned on (reference group)
HCC_1 – One HCC flag turned on
HCC_2 -- Two HCC flags turned on
HCC_3 – Three HCC flags turned on
HCC4_5 – Four or five HCC flags turned on
HCC6_OR_MORE – Six or more HCC flags turned on
NEW_ENROLLEE – No HCC flags because the enrollee was new to Medicare

The HCC categories used in the OCM model are listed in the document "OCM Prediction Model Code Lists," which is available on the OCM Portal. Note that some of the categories are hierarchical, consistent with the hierarchies established for Medicare Advantage payment policy. If flags for a more severe and a less severe version of a specific condition are present then only the flag associated with the more severe version of the condition is counted.

10. History of Prior Chemotherapy Use

Episodes where the beneficiary has a history of chemotherapy use often tend to be less expensive than those without such a history. The episode start date minus the date of the most recent

chemotherapy claim before the episode start date is referred to as the "clean period." There are three variables related to length of the clean period:

CLEAN_1_61 – Clean period between 1 and 61 days
CLEAN_62_730 – Clean period between 62 and 730 days
CLEAN_731+ – Clean period over 730 days or no prior chemo claims (reference group)

Beneficiaries with recent Medicare enrollment have little or no Medicare claims history and will be categorized in the CLEAN_731+ group if they have no observable prior chemotherapy use. These beneficiaries will be distinguished in the model by the NEW_ENROLLEE variable described in Section 9 above.

11. Institutional Status

The variable INSTITUTIONAL_STATUS measures whether the beneficiary had been institutionalized in a long term care facility for more than 90 days as of the month in which the episode started. This variable is obtained from CMS' HCC files, which contain monthly indicators for residence in a long term care facility. CMS derives these monthly indicators from the Minimum Data Set (MDS), which contains assessment information collected from skilled nursing facilities.

12. Episode Length

Episodes have a fixed length of 6 calendar months, which results in a variable number of days (180 – 183 days) depending on which calendar months are included in the episode. The variable EP_182_183 represents episodes with a length of 182 or 183 days compared to those with a length of 180 or 181 days.

13. Geographic Location/Hospital Referral Region

A geographic adjustment will be made to distinguish episodes occurring in high- and low-cost areas. The geographic unit will be hospital referral region (HRR). There are 307 such areas defined by the Dartmouth Institute for Health Policy and Clinical Practice to reflect regional healthcare markets for tertiary hospital care.[1] Beneficiary zip codes were mapped to the HRRs for purposes of assigning a specific HRR to each episode. The average baseline episode cost in each HRR was divided by the average baseline cost of all episodes to obtain a relative episode cost for each HRR. The geographic adjustment was then operationalized as:

HRR_RELATIVE_COST = [(Average episode cost for the HRR/Average episode cost across all HRRs) – 1] * 100.

[1] Dartmouth Institute for Health Policy and Clinical Practice. The Dartmouth Atlas of Health Care. Available at http://www.dartmouthatlas.org/.

By subtracting one from the ratio of average costs the variable is anchored at zero. Episodes in HRRs with higher than average costs will see an increase in predicted costs and episodes in HRRs with lower than average costs will see a decrease in predicted costs. The variable captures the percentage difference in average episode costs between a given HRR and all HRRs. This variable is continuous.

Summary

The table below lists all of the variables used in the OCM prediction model and their descriptions. All variables take values of either zero or one except for the HRR_RELATIVE_COST, which is a continuous variable. Model coefficients and other regression output are summarized in the document "Model Coefficients," which is available on the OCM Portal.

Table 1: OCM Prediction Model Variables

Variable Name	Description (if value=1)
FEMALE_AGE_18_64	Female, age 18 to 64
FEMALE_AGE_65_69	Female, age 65 to 69 (reference group)
FEMALE_AGE_70_74	Female, age 70 to 74
FEMALE_AGE_75_79	Female, age 75 to 79
FEMALE_AGE_80+	Female, age 80 or greater
MALE_AGE_18_64	Male, age 18 to 64
MALE_AGE_65_69	Male, age 65 to 69
MALE_AGE_70_74	Male, age 70 to 74
MALE_AGE_75_79	Male, age 75 to 79
MALE_AGE_80+	Male, age 80 or greater
BREAST_PART_D_ONLY_WITH_SURGERY	Breast cancer, only part D chemotherapy drugs, with surgery
BREAST_PART_D_ONLY_WITHOUT_SURGERY	Breast cancer, only part D chemotherapy drugs, without surgery (reference group)
BREAST_PART_B_WITH_SURGERY	Breast cancer, at least some Part B chemotherapy drugs, with surgery
BREAST_PART_B_WITHOUT_SURGERY	Breast cancer, at least some Part B chemotherapy drugs, without surgery
ANAL_WITH_SURGERY	Anal cancer, with surgery
ANAL_WITHOUT_SURGERY	Anal cancer, without surgery
BLADDER_WITH_SURGERY	Bladder cancer, with surgery
BLADDER_WITHOUT_SURGERY	Bladder cancer without surgery
FEMALE_GU_WITH_SURGERY	Female GU cancer other than ovary, with surgery
FEMALE_GU_WITHOUT_SURGERY	Female GU cancer other than ovary, without surgery
GASTRO_WITH_SURGERY	Gastro/Esophageal cancer, with surgery

Variable Name	Description (if value=1)
GASTRO_WITHOUT_SURGERY	Gastro/Esophageal cancer, without surgery
HEAD_NECK_WITH_SURGERY	Head and neck cancer, with surgery
HEAD_NECK_WITHOUT_SURGERY	Head and neck cancer, without surgery
INTESTINAL_WITH_SURGERY	Intestinal cancer, with surgery
INTESTINAL_WITHOUT_SURGERY	Intestinal cancer, without surgery
LIVER_WITH_SURGERY	Liver cancer, with surgery
LIVER_WITHOUT_SURGERY	Liver cancer, without surgery
LUNG_WITH_SURGERY	Lung cancer, with surgery
LUNG_WITHOUT_SURGERY	Lung cancer, without surgery
OVARY_WITH_SURGERY	Ovarian cancer, with surgery
OVARY_WITHOUT_SURGERY	Ovarian cancer, without surgery
PANCREAS_WITH_SURGERY	Pancreatic cancer, with surgery
PANCREAS_WITHOUT_SURGERY	Pancreatic cancer, without surgery
PROSTATE_WITH_SURGERY	Prostate cancer, with surgery
PROSTATE_WITHOUT_SURGERY	Prostate cancer, without surgery
ACUTE_LEUKEMIA	Acute leukemia
CHRONIC_LEUKEMIA	Chronic leukemia
CNS	CNS tumor
ENDOCRINE	Endocrine tumor
KIDNEY	Kidney cancer
LYMPHOMA	Lymphoma
MDS	Myelodysplastic Syndrome
MELANOMA	Malignant melanoma
MYELOMA	Multiple myeloma
FULL_DUAL	Enrolled in Part D, full dual, LIS
PART_D_LIS	Enrolled in Part D, partial dual or LIS applicant, LIS
PART_D_NO_LIS	Enrolled in Part D, no LIS
NO_PART_D	Not enrolled in Part D (reference group)
RADIATION	Received radiation therapy during episode
BMT_ALLOGENEIC	Received allogeneic BMT during episode
BMT_AUTOLOGOUS	Received autologous BMT during episode
CLINICAL_TRIAL	Participated in a clinical trial for cancer during episode
HCC_0	No HCC flags turned on (reference group)
HCC_1	One HCC flag turned on
HCC_2	Two HCC flags turned on
HCC_3	Three HCC flags turned on
HCC4_5	Four or five HCC flags turned on

Variable Name	Description (if value=1)
HCC6_OR_MORE	Six or more HCC flags turned on
New enrollee	New Medicare enrollee (no HCC flags turned on)
CLEAN_1_61	Clean period between 1 and 61 days
CLEAN_62_730	Clean period between 62 and 730 days
CLEAN_731+	Clean period over 730 days or no prior chemo claims (reference group)
INSTITUTIONAL_STATUS	Was institutionalized for more than 90 days as of the month the episode began
EP_182_183	Episode length 182 – 183 days
HRR_RELATIVE_COST	Episode expenditures in beneficiary's HRR relative to average episode expenditures in all HRRs