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Article

The Oncology Care Model and Adherence to Oral Cancer Drugs: A Difference-in-Differences Analysis

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Abstract

Background: Adherence to oral cancer drugs is suboptimal. The Oncology Care Model (OCM) offers oncology practices financial incentives to improve the value of cancer care. We assessed the impact of OCM on adherence to oral cancer therapy for chronic myelogenous leukemia (CML), prostate cancer, and breast cancer. **Methods:** Using 2014-2019 Medicare data, we studied chemotherapy episodes for Medicare fee-for-service beneficiaries prescribed tyrosine kinase inhibitors (TKIs) for CML, antiandrogens (ie, enzalutamide, abiraterone) for prostate cancer, or hormonal therapies for breast cancer in OCM-participating and propensity-matched comparison practices. We measured adherence as the proportion of days covered and used difference-in-difference (DID) models to detect changes in adherence over time, adjusting for patient, practice, and market-level characteristics. **Results:** There was no overall impact of OCM on improved adherence to TKIs for CML (DID = −0.3%, 90% confidence interval [CI] = −1.2% to 0.6%), antiandrogens for prostate cancer (DID = 0.4%, 90% CI = −0.3% to 1.2%), or hormonal therapy for breast cancer (DID = 0.0%, 90% CI = −0.2% to 0.2%). Among episodes for Black beneficiaries in OCM practices, for whom adherence was lower than for White beneficiaries at baseline, we observed small improvements in adherence to high cost TKIs (DID = 3.0%, 90% CI = 0.2% to 5.8%) and antiandrogens (DID = 2.2%, 90% CI = 0.2% to 4.3%). **Conclusions:** OCM did not impact adherence to oral cancer therapies for Medicare beneficiaries with CML, prostate cancer, or breast cancer overall but modestly improved adherence to high-cost TKIs and antiandrogens for Black beneficiaries, who had somewhat lower adherence than White beneficiaries at baseline. Patient navigation and financial counseling are potential mechanisms for improvement among Black beneficiaries.

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Oral cancer drugs have an increasingly important role in cancer treatment. Unlike infused cancer therapies delivered in the office, oral cancer treatments require patients to ingest medication on a regular schedule, often daily. However, adherence to daily medications may be challenging for some patients, even for highly effective cancer therapies. For example, oral tyrosine kinase inhibitors (TKIs) for chronic myelogenous leukemia (CML) are targeted therapies that have transformed CML from a condition with a median survival of 5 to 6 years to a condition with near normal life expectancy (1-3). Adherence is essential because treatment interruption may lead to recurrent and/or treatment-resistant disease (4). Nevertheless, prior research documented adherence rates of only 61% among newly diagnosed Medicare beneficiaries with CML who initiated TKI therapy (5). Adherence is suboptimal for other frequently prescribed and effective oral cancer therapies. For example, enzalutamide and abiraterone prolong survival for men with metastatic or locally advanced prostate cancer, but a recent report documented mean adherence rates among Medicare beneficiaries of 75%, with substantial variability across geographic areas (6). Oral therapies also have an important role in breast cancer treatment, where patients with hormone receptor–positive, early

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stage breast cancer are typically prescribed adjuvant hormonal therapy for 5 to 10 years. Studies have consistently documented suboptimal adherence to hormonal therapy for breast cancer (7-9). Potentially modifiable barriers to adherence include managing side effects, patient beliefs and perceptions, poor patient–provider communication, and high medication cost (10).

The Centers for Medicare & Medicaid Services' Oncology Care Model (OCM) is an alternative payment model that provides structured incentives to oncology practices to improve the quality and efficiency of cancer care for Medicare beneficiaries undergoing chemotherapy. In its first 3 years, OCM has led to modest savings in Medicare total episode payments that were not sufficient to cover the monthly payments provided by the program to support delivery of enhanced oncology services (11).

Practices participating in OCM are required to provide enhanced oncology services for Medicare beneficiaries undergoing chemotherapy. For example, OCM participating practices must provide the core functions of patient navigation. In some practices, navigators routinely contact beneficiaries prescribed oral cancer drugs to assess for adverse effects of therapy and to identify and overcome barriers to medication adherence (12-14). OCM also requires practices to document 13 essential "care elements" described by the Institute of Medicine (15), including out-of-pocket cost estimates for patients before they start a new cancer therapy. Most participating practices employ financial counselors to provide this cost information and to identify resources for financial assistance (12,13). Given the high cost sharing for Medicare Part D (16,17), beneficiaries requiring oral cancer drugs may be particularly likely to benefit from such services.

To determine whether OCM's focus on care coordination, patient navigation, and financial transparency increased adherence to oral cancer therapies, we examined changes in adherence over time to TKIs for beneficiaries with CML, the antiandrogens enzalutamide and abiraterone for beneficiaries with prostate cancer, and oral hormonal therapies for beneficiaries with breast cancer. We hypothesized that the enhanced oncology services associated with OCM participation would increase adherence to these therapies. We expected that effects would be greater for high-cost drugs such as TKIs, abiraterone, and enzalutamide, for which annual out-of-pocket expenditures may exceed $10 000 for Medicare Part D beneficiaries without low-income subsidies (17). In secondary analyses, we assessed if there were differential impacts on adherence by race and ethnicity, given prior evidence showing lower adherence among patients of color (18,19), which may be in part be due to greater financial toxicity (20,21).

Methods

Data, Beneficiaries, and General Approach

Methods for the OCM evaluation have been described previously (11). The study was approved by the Abt Associates institutional review board with a waiver of informed consent. We used Medicare administrative data for beneficiaries of all ages with fee-for-service Medicare (excepting end-stage renal disease beneficiaries) who initiated systemic cancer therapies during 2014-2018. Beneficiaries filling prescriptions for oral chemotherapy triggered a chemotherapy episode if a claim with a cancer diagnosis was present on the prescription fill date or in the preceding 59 days and were continuously enrolled through the 6-month episode (or death). Episodes were attributed to the oncology practice (based on tax identification number) that provided the plurality of cancer-related evaluation and management visits during the episode. We used a difference-in-difference (DID) design (22) to compare trends in adherence over time among episodes for beneficiaries enrolled in Part D treated in physician practices participating in OCM (n = 201), compared with episodes for beneficiaries treated in comparison practices not participating in OCM. Comparison practices (n = 534) were selected based on propensity-score matching on patient, practice, and market-level attributes using Medicare data and external data on market-level characteristics from 2014 to 2016 (11-13,23). We studied adherence in the baseline period (6-month episodes starting July 2, 2014, through January 1, 2016, and ending by June 30, 2016) and the intervention period (6-month episodes starting July 1, 2016, through January 1, 2019, and ending by June 30, 2019).

Analyses focused on beneficiary episodes for chronic leukemia treated with TKIs (imatinib, dasatinib, nilotinib, bosutinib, ponatinib); prostate cancer treated with enzalutamide or abiraterone; or breast cancer treated with tamoxifen, anastrozole, exemestane, or letrozole and no other systemic cancer therapy. Additional details are included in the Supplementary Methods (available online).

Adherence

To measure adherence, we calculated the proportion of days covered (PDC) by summing the number of actual days' supply dispensed divided by the number of days between the index fill of the drug of interest and the last day of the 6-month episode (or the date of death or hospice enrollment). PDC is recommended by the Pharmacy Quality Alliance for measuring adherence in studies using administrative data (24). For each analysis, beneficiaries could switch from one drug in the class to another; beneficiaries were censored if they switched to another drug of a different type (eg, chemotherapy) suggesting disease progression. Additional details are included in the Supplementary Methods (available online).

Control Variables

Analyses were adjusted for beneficiary, practice, and market characteristics that might be associated with adherence and included all variables in the propensity score matching models (12,13). The comparison practices were selected to assess a broad range of outcomes, rather than specifically for assessment of adherence for the clinical scenarios described here. The OCM and comparison episodes remained well balanced (see Table 1; Supplementary Table 1, available online). We additionally adjusted for beneficiary, practice, and market characteristics to account for any residual differences. Beneficiary characteristics included age (younger than 65, 65-69, 70-74, 75-79, 80-84, 85 years and older), sex, race, and ethnicity based on the Research Triangle Institute race variable in the Medicare enrollment file (Hispanic; non-Hispanic Black or Black; non-Hispanic White or White; Other, including American Indian and Alaska Native, Asian and Pacific Islander, and 1.2% with unknown race and ethnicity), dual eligibility, disease severity as measured by Hierarchical Condition Categories (HCC) risk score (categorized in approximate quartiles), cancer type, and previous cancer treatment episode (yes or no). Practice characteristics (based on the practice billing unit or tax identification number) included volume of episodes, 3 or fewer oncology

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providers, affiliation with an academic medical center, health system affiliation and hospital ownership (an indicator was included for <0.5% of episodes with missing data on affiliation and ownership), provider mix (oncology-only specialists as well as flags for radiation oncologists, surgical oncologists, and/or gynecologic oncologists), and proportion of providers who are nurse practitioners or physician assistants. Market characteristics defined at the county level included total population, percent of population aged 65 years or older, percent living in poverty, Medicare Advantage penetration, proportion of population in primary health-care shortage area, ratio of specialists to generalists, emergency visits resulting in inpatient stays in the fee-for-service Medicare population, and state indicators.

Analyses

For each beneficiary episode during the baseline and intervention periods, we calculated the PDC. Using DID models, we assessed change in PDC from the baseline period to the intervention period for episodes attributed to OCM vs comparison practices, with an interaction term between intervention (vs baseline) period and treatment group (OCM vs comparison) to assess the impact of OCM. We employed linear models to adjust for beneficiary, practice, and market factors described above and accounted for clustering of observations within practices. We repeated analyses stratified by race and ethnicity for Black, Hispanic, and White; beneficiaries; and subgroups with reasonable sample sizes.

We present DID results as point estimates of adherence with upper and lower confidence intervals (CI) at the 90% level. Two-sided *P* values of .10 were used throughout the OCM evaluation to reduce the likelihood of missing effects of the model. Because a key assumption of DID models is that differences between treatment and comparison groups were constant in the baseline period, we compared quarterly trends in adherence during the baseline period and found them to be similar (Supplementary Figures 1-4, available online). In sensitivity analyses, we repeated DID models after removing the 2 largest OCM practices for which there were no comparison practices of comparable size to ensure that results were not driven by these 2 large practices (25). Results of this sensitivity analysis were similar and are not presented. We additionally conducted sensitivity analyses restricting the nonstratified cohorts to beneficiaries who were new users of the drugs (defined as no fills in the prior 6 months).

Results

Beneficiary Episode Characteristics

There were 25 481 CML 6-month episodes with fills for TKIs (imatinib, dasatinib, nilotinib, bosutinib, and ponatinib) during the baseline and intervention periods; 42.3% of beneficiaries with episodes were aged younger than 70 years (Table 1). There were 51 176 episodes with fills for enzalutamide or abiraterone treatment for prostate cancer; 20.8% of beneficiaries were aged younger than 70 years. There were 490 357 episodes with fills for hormonal therapies (tamoxifen, anastrozole, exemestane, letrozole) for low-risk breast cancer; 36.7% of beneficiaries were aged younger than 70 years. Additional characteristics of the beneficiary episodes are included in Table 1 and Supplementary Table 1 (available online).

Adherence

As shown in Table 2, adherence was generally high at baseline, with PDCs of more than 85% for all classes of drugs and more than 90% for hormonal therapies for breast cancer. Adherence to TKIs for CML declined slightly in both OCM and comparison episodes between the baseline and intervention periods with no relative impact of OCM (DID impact estimate = −0.3 percentage point change for OCM relative to comparison episodes, 90% CI = −1.2% to 0.6%; *P* = .60) (Table 2). Similar patterns were evident for each of the 3 most frequently prescribed TKIs individually (imatinib, dasatinib, and nilotinib) (Supplementary Table 2, available online). For beneficiaries with prostate cancer, adherence to enzalutamide or abiraterone declined in both OCM and comparison episodes, with no relative impact of OCM (DID impact estimate = 0.4 percentage point PDC increase relative to comparisons episodes, 90% CI = −0.3% to 1.2%; *P* = .34; Table 2). Patterns of adherence were similar for both enzalutamide and abiraterone (Supplementary Table 3, available online). Adherence to hormonal therapy for breast cancer remained relatively stable in OCM and comparison episodes, with no relative impact of OCM on adherence (DID estimate = 0.0 percentage points, 90% CI = −0.2% to 0.2%; *P* = .86). Results were similar for tamoxifen and letrozole (Supplementary Table 4, available online). There was a small relative decline in adherence to anastrozole (DID impact estimate = −0.3%, 90% CI = −0.6% to −0.1%; *P* = .03) and a small relative increase in adherence to exemestane (DID impact estimate = 0.8%, 90% CI = 0.1% to 1.6%; *P* = .06; Supplementary Table 4, available online). Full model results are included in Supplementary Tables 5-7 (available online).

In analyses stratified by race and ethnicity, adherence in the baseline period was lower for Black beneficiaries than for White beneficiaries, particularly for the high-cost TKIs for CML and abiraterone or enzalutamide for prostate cancer (Table 3). OCM led to improved adherence to these drugs among Black beneficiaries (DID impact estimate = 3.0 percentage point increase for TKIs for CML, 90% CI = 0.2% to 5.8%, and 2.2 percentage point increase for abiraterone or enzalutamide, 90% CI = 0.2% to 4.3%) with no OCM impact on adherence to these drugs for Hispanic or White beneficiaries. There was no OCM impact on adherence to lower-cost hormonal therapy for breast cancer for any racial and ethnic subgroup (Table 3).

In sensitivity analyses restricting the full cohorts to likely new users (no fill of the drug in the prior 6 months), we observed no impact of OCM, although confidence intervals were wide (Supplementary Table 8, available online).

Discussion

OCM is an alternative payment model that seeks to improve the quality and efficiency of cancer treatment. We observed relatively high adherence to oral cancer medications at baseline for beneficiaries with CML, prostate cancer, and breast cancer in both OCM and comparison episodes. Practice participation in OCM did not improve patients' adherence to oral cancer therapies. However, adherence to high-priced TKIs, enzalutamide, and abiraterone improved modestly among Black beneficiaries in OCM episodes relative to comparison episodes, for whom adherence was somewhat lower at baseline.

As oral cancer therapies are introduced for a growing number of oncologic indications, adherence to therapy becomes increasingly important. Unlike infused chemotherapies, whose administration is rigorously supervised, oncologists do not observe ingestion of oral therapies, and evidence suggests that

Table 1. Characteristics of OCM and comparison episodes

Characteristics	Chronic myelogenous leukemia cohort				High-risk prostate cancer cohort				Low-risk breast cancer cohort			
	OCM baseline	OCM intervention	Comparison baseline	Comparison intervention	OCM baseline	OCM intervention	Comparison baseline	Comparison intervention	OCM Baseline	OCM Intervention	Comparison Baseline	Comparison Intervention
No. of episodes	4349	7803	4921	8408	8131	14 919	10 358	17 768	81 887	155 916	93 258	159 296
Sex, No. (%)												
Male	2008 (46.2)	3710 (47.5)	2214 (45.0)	3942 (46.9)	8131 (100)	14 919 (100)	10 358 (100)	17 768 (100)	680 (0.8)	1298 (0.8)	802 (0.9)	1292 (0.8)
Female	2341 (53.8)	4093 (52.5)	2707 (55.0)	4466 (53.1)	—	—	—	—	81 207 (99.2)	154 618 (99.2)	92 456 (99.1)	158 004 (99.2)
Age, No. (%), y												
Younger than 65	826 (19.0)	1481 (19.0)	1180 (24.0)	1957 (23.3)	267 (3.3)	574 (3.8)	431 (4.2)	822 (4.6)	6395 (7.8)	9900 (6.3)	8798 (9.4)	12 390 (7.8)
65-69	905 (20.8)	1706 (21.9)	1080 (21.9)	1657 (19.7)	1237 (15.2)	2572 (17.2)	1622 (15.7)	3109 (17.5)	24 349 (29.7)	45 426 (29.1)	26 886 (28.8)	45 876 (28.8)
70-74	1020 (23.5)	1677 (21.5)	985 (20.0)	1757 (20.9)	1858 (22.9)	3256 (21.8)	2295 (22.2)	3926 (22.1)	20 504 (25.0)	42 487 (27.2)	22 866 (24.5)	42 751 (26.8)
75-79	843 (19.4)	1466 (18.8)	824 (16.7)	1391 (16.5)	1808 (22.2)	3303 (22.1)	2229 (21.5)	3834 (21.6)	14 807 (18.1)	29 649 (19.0)	16 414 (17.6)	29 181 (18.3)
80-84	418 (9.6)	908 (11.6)	473 (9.6)	959 (11.4)	1542 (19.0)	2787 (18.7)	1911 (18.4)	3090 (17.4)	9026 (11.0)	16 388 (10.5)	10 527 (11.3)	16 814 (10.6)
Older than 84	337 (7.7)	565 (7.2)	379 (7.7)	687 (8.2)	1419 (17.5)	2427 (16.3)	1870 (18.1)	2987 (16.8)	6806 (8.3)	12 066 (7.7)	7767 (8.3)	12 284 (7.7)
Race and ethnicity, No. (%)												
Black	384 (8.8)	672 (8.6)	488 (9.9)	817 (9.7)	1006 (12.4)	1803 (12.1)	1261 (12.2)	2256 (12.7)	6797 (8.3)	11 981 (7.7)	8062 (8.6)	12 251 (7.7)
Hispanic	293 (6.7)	588 (7.5)	289 (5.9)	533 (6.3)	459 (5.6)	856 (5.7)	500 (4.8)	907 (5.1)	3885 (4.7)	7492 (4.8)	3926 (4.2)	6625 (4.2)
Other	180 (4.1)	416 (5.3)	175 (3.6)	391 (4.7)	270 (3.3)	700 (4.7)	400 (3.9)	907 (5.1)	2565 (3.1)	5996 (3.8)	3095 (3.3)	6808 (4.3)
White	3492 (80.3)	6127 (78.5)	3969 (80.7)	6667 (79.3)	6396 (78.7)	11 560 (77.5)	8197 (79.1)	13 698 (77.1)	68 640 (83.8)	130 447 (83.7)	78 175 (83.8)	133 612 (83.9)
Dual eligible, No. (%)												
Yes	1033 (23.8)	2048 (26.2)	1456 (29.6)	2610 (31.0)	1173 (14.4)	2409 (16.1)	1511 (14.6)	3275 (18.4)	13 312 (16.3)	22 763 (14.6)	18 227 (19.5)	26 697 (16.8)
No	3316 (76.2)	5755 (73.8)	3465 (70.4)	5798 (69.0)	6958 (85.6)	12 510 (83.9)	8847 (85.4)	14 493 (81.6)	68 575 (83.7)	133 153 (85.4)	75 031 (80.5)	132 599 (83.2)
HCC risk score, No. (%)[a]												
0-0.99	163 (3.7)	273 (3.5)	163 (3.3)	239 (2.8)	1068 (13.1)	1897 (12.7)	1312 (12.7)	2136 (12.0)	46 212 (56.4)	85 022 (54.5)	50 965 (54.6)	84 349 (53.0)
1.00-1.99	2491 (57.3)	4141 (53.1)	2798 (56.9)	4490 (53.4)	896 (11.0)	1601 (10.7)	1220 (11.8)	2004 (11.3)	23 463 (28.7)	47 489 (30.5)	27 553 (29.5)	49 279 (30.9)
2.00-3.99	1028 (23.6)	2002 (25.7)	1220 (24.8)	2117 (25.2)	3370 (41.4)	5770 (38.7)	4270 (41.2)	7016 (39.5)	8434 (10.3)	15 852 (10.2)	10 195 (10.9)	16 915 (10.6)
≥4.00	667 (15.3)	1387 (17.8)	740 (15.0)	1562 (18.6)	2797 (34.4)	5651 (37.9)	3556 (34.3)	6612 (37.2)	3778 (4.6)	7553 (4.8)	4545 (4.9)	8753 (5.5)

[a]HCC risk scores are normalized to a value of 1.0 among all Medicare beneficiaries; individuals with risk scores <1 are expected to be less costly than the average beneficiary; those with risk scores >1 are expected to be more costly than the average beneficiary. A risk score of 0.5 means that costs are expected to be half that of an average beneficiary; a score of 2.0 means costs are expected to be twice that of an average beneficiary. HCC scores were calculated over all beneficiaries participating in OCM. The risk scores reflect severity of the cancer (beneficiaries with metastatic or more serious cancers have higher risk scores) as well as comorbid illness. HCC = hierarchical condition category; OCM = Oncology Care Model.

Table 2. Impact of OCM on adherence to oral drugs for CML, prostate cancer, and hormonal therapy for breast cancer

	No. of episodes		OCM proportion of days covered		Comparison proportion of days covered		Impact estimates[a]	
Proportion of days covered	OCM	Comparison	Baseline, %	Intervention, %	Baseline, %	Intervention, %	DID (90% CI), %	P[b]
All tyrosine kinase inhibitors	12 152	13 329	87.6	86.1	88.1	86.8	−0.3 (−1.2 to 0.6)	.60
Enzalutamide or abiraterone	23 050	28 126	88.6	84.5	89.1	84.5	0.4 (−0.3 to 1.2)	.34
Hormonal therapy for breast cancer	237 803	252 554	90.4	90.8	90.7	91.1	0.0 (−0.2 to 0.2)	.86

[a]Full model results are included in Supplementary Tables 5-7 (available online). CI = confidence interval; CML = chronic myelogenous leukemia; DID = difference-in-difference estimate; OCM = Oncology Care Model intervention group.
[b]Impact estimates and 2-sided *P* values based on difference-in-differences regression analysis.

Table 3. Impact of OCM on adherence to oral drugs for CML, prostate cancer, and hormonal therapy for breast cancer by race and ethnicity

	No. of episodes		OCM proportion of days covered		Comparison proportion of days covered		Impact estimates	
Proportion of days covered	OCM	Comparison	Baseline, %	Intervention, %	Baseline, %	Intervention, %	DID (90% CI), %	P[a]
Tyrosine kinase inhibitors for chronic myelogenous leukemia								
Black	1056	1305	82.7	85.1	85.2	84.7	3.0 (0.2 to 5.8)	.08
Hispanic	881	822	84.9	84.2	86.9	88.9	−2.7 (−6.5 to 1.1)	.25
White	9619	10 636	88.5	86.4	88.3	86.8	−0.6 (−1.6 to 0.4)	.33
Enzalutamide or abiraterone for prostate cancer								
Black	2809	3517	86.0	84.4	87.2	83.3	2.2 (0.2 to 4.3)	.08
Hispanic	1315	1407	87.0	84.0	88.3	85.0	0.3 (−2.6 to 3.2)	.88
White	17 956	21 895	89.2	84.3	89.5	84.7	0.0 (−0.8 to 0.9)	.96
Hormonal therapy for breast cancer								
Black	18 778	20 313	88.6	89.2	88.3	89.2	−0.3 (−1.0 to 0.3)	.38
Hispanic	11 377	10 551	89.4	90.0	89.8	89.9	0.6 (−0.2 to 1.4)	.24
White	199 087	211 787	90.6	91.0	90.9	91.3	0.1 (−0.1 to 0.3)	.54

[a]Impact estimates and 2-sided *P* values based on difference-in-differences regression analysis. CI = confidence interval; CML = chronic myelogenous leukemia; DID = difference-in-difference estimate; OCM = Oncology Care Model intervention group.

adherence to oral cancer therapies is often suboptimal (5,7-9,26). Adherence to oral therapies was higher among beneficiary episodes in our study than in other reports, likely because we studied chemotherapy episodes that were triggered by the dispensing of the oral cancer drug. In other words, beneficiaries who were not filling their oral prescriptions regularly would trigger fewer OCM-defined chemotherapy episodes and would be underrepresented in our episode-level data. Nevertheless, adherence in the baseline period for TKIs and enzalutamide or abiraterone was less than 90% and declined during the intervention period in the intervention and comparison groups.

Strategies to ensure that patients are filling prescriptions and taking cancer therapies are critically important if patients are to realize the benefits of these treatments. Although OCM was a policy intervention, a goal was to improve the delivery of care to beneficiaries with cancer, and many OCM practices made changes in response to OCM that might positively impact adherence. For example, many OCM practices employ patient navigators and pharmacists to ensure that their patients are taking oral cancer drugs as prescribed while mitigating physical toxicities that may hinder adherence (12,13). These clinicians may have helped beneficiaries overcome barriers to adherence by sharing medication management strategies and providing patient education. A recent innovative pharmacist-led intervention improved adherence and molecular response outcomes for patients with CML (27). Additionally, many OCM practices employ financial counselors to help patients address financial barriers to adherence (12,13). A recent review of adherence-promoting interventions for oral cancer agents suggests that interventions directed by pharmacists and involving regular monitoring show promise (28). Our findings suggest that these efforts as implemented by practices participating in OCM did not have large impacts—this could be because of limited effects of any OCM-related changes or similar changes in comparison practices. Nevertheless, in subgroup analyses, we observed OCM-related adherence improvements for Black beneficiaries for 2 classes of high-priced oral therapies and not for lower-priced hormonal therapies for breast cancer. Note that although generic imatinib became available during the study period, out-of-pocket costs for generic imatinib remained high because of the Part D benefit design (29). Other research suggests that Black individuals may have lower adherence than White

individuals to hormonal therapies for breast cancer (8,18,19,30), but fewer studies have assessed adherence to other oral cancer drugs. Two studies of adherence to TKI therapy for chronic myeloid leukemia for patients treated in 2007-2012 did not identify differences by race (5,31); however, prior evidence has found that even modest cost sharing for TKIs is associated with lower adherence rates to these medications (26). An analysis of the National Health Interview Survey found that among older cancer survivors, 12.7% reported cost-related nonadherence to medications, with higher rates among Black and Hispanic individuals than Whites (32). Black individuals with cancer report more financial toxicity than do White individuals (defined as having to pay more for medical care than they can afford) (20), and financial toxicity and greater financial burden are strongly related to nonadherence to oral cancer drugs (20,21). Patient navigation (33) and financial counseling may be particularly beneficial for individuals experiencing high out-of-pocket costs, as is the case for Medicare beneficiaries without low-income subsidies who take high-priced oral cancer drugs (16,17).

This analysis has several limitations. We studied adherence for Medicare fee-for-service beneficiaries with 3 cancers for which oral drugs are key therapies; our findings may not generalize to other oral cancer drugs or individuals with other insurance. Also, we were unable to assess primary nonadherence (not filling a first prescription), and we studied beneficiaries who filled their medications frequently enough to trigger a chemotherapy episode; our findings may not generalize to patients with much lower adherence. Second, we used prescription fills to assess adherence; we cannot be sure that once filled, beneficiaries ingested medications as prescribed. It is also possible that some beneficiaries were advised to discontinue TKI therapy, given evidence that some individuals may be able to safely discontinue TKIs if a sustained molecular response is achieved (34,35). We also could not identify if beneficiaries were using prescription assistance programs, and our analyses did not adjust for polypharmacy, although we have no reason to suspect these factors differed for OCM and comparison episodes. Third, our DID analysis relies on an appropriate comparison group to estimate counterfactual trends in the absence of the OCM intervention. We selected comparison practices based on numerous baseline characteristics—baseline trends were very similar for OCM and comparison episodes—and we have found no evidence that characteristics of OCM and comparison episodes are changing differentially over time (12); however, there could be unobserved differences. OCM was a voluntary model, and participating practices were more often larger, multisite, and affiliated with academic centers than comparison practices; they also may have differed in their use of innovative strategies for improving adherence. Fourth, we studied the impact of a policy intervention and thus cannot comment on specific practice-level interventions that may or may not improve adherence, nor did we have information about whether comparison practices may have expanded services that might promote adherence, even without the incentives provided by OCM. We assessed race and ethnicity from administrative data, which has high validity for self-reported Black race but may underascertain some Hispanic beneficiaries (33). Finally, we used prespecified 2-sided P values set at the .10 limit to avoid missing program effects. It is possible that the race-specific findings we observed reflect a type 1 error.

In summary, for beneficiaries with CML, prostate cancer, or breast cancer, OCM-related care delivery changes did not impact adherence to oral drugs overall but modestly increased adherence to 2 classes of expensive oral therapies for Black beneficiaries, for whom adherence was somewhat lower at baseline. Additional research is needed to identify effective practice-level interventions to promote adherence to oral cancer treatments.

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Data Availability

The data underlying this article were accessed from the Centers for Medicare & Medicaid Services Virtual Research Data Center. The derived data generated in this research are covered under a data use agreement that does not allow sharing with third parties to protect the privacy of research subjects.

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