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# Changes in Chronic Medication Adherence, Costs, and Healthcare Utilization after a Cancer Diagnosis among Low-Income Patients and the Role of Patient-Centered Medical Homes

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## Abstract

**Background:** Forty percent of cancer patients also have another chronic medical condition. Patient-centered medical homes (PCMHs) have improved outcomes among patients with multiple chronic comorbidities. We first evaluated the impact of a cancer diagnosis on Medicaid patients' chronic medication adherence and, second, whether PCMHs influenced cancer patients' outcomes.

**Methods:** Using linked 2004–2010 North Carolina cancer registry and claims data, we included Medicaid enrollees diagnosed with breast, colorectal, or lung cancer who had hyperlipidemia, hypertension, and/or diabetes mellitus. Using difference-in-difference methods, we examined how adherence to chronic disease medications as measured by the change in proportion of days covered

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(PDC) over time among cancer and non-cancer patients. We then further evaluated whether PCMH enrollment modified the observed differences between those with and without cancer using a differences-in-differences-in-differences approach. We examined changes in healthcare expenditures and utilization as secondary outcomes.

**Results:** Newly diagnosed cancer patients with hyperlipidemia experienced a 7–11 percentage point decrease in PDC compared to non-cancer patients. Cancer patients also experienced significant increases in medical expenditures and hospitalizations compared to non-cancer controls. Changes in medication adherence over time between cancer and non-cancer patients were not statistically significantly different by PCMH status. Some PCMH cancer patients experienced smaller increases in expenditures (diabetes) and emergency department (ED) use (hyperlipidemia) but larger increases in their inpatient hospitalization rates (hypertension) than non-PCMH cancer patients, relative to non-cancer patients.

**Conclusions:** PCMHs were not associated with improvements in chronic disease medication adherence, but were associated with lower costs and ED visits, among some low-income cancer patients.

## Precis:

We found low-income cancer patients with chronic conditions had worse adherence to chronic medications, higher costs, and higher healthcare utilization around the time of their cancer diagnosis. Changes in chronic medication adherence for cancer patients relative to non-cancer patients were no different for those in patient-centered medical homes; future studies should examine a variety of approaches that can help mitigate the multidimensional burden of cancer in low-income populations.

### Keywords

cancer; chronic conditions; medication adherence; healthcare utilization; patient-centered medical homes

## INTRODUCTION

In the US, 13,000 practices and 67,000 clinicians are part of patient-centered medical homes (PCMHs).[1] Developed to aid in transitioning from volume to value-based care, PCMHs use a team-based healthcare delivery system to improve patient outcomes and decrease medical costs through comprehensive care coordination. The Agency for Healthcare Research and Quality defines PCMHs as having 5 core attributes of care: 1) comprehensiveness, 2) patient-centeredness, 3) coordination, 4) accessible services, and 5) quality and safety.[2] Currently, evidence on the effectiveness of PCMHs has been mixed. A 2017 meta-analysis found that PCMHs had no significant effect on primary care visits, emergency department (ED) use, or inpatient hospitalizations.[3] However, among patients with multiple chronic comorbidities, PCMHs reduced specialty visits, increased cancer screening, decreased medical expenditures, and improved medication adherence.[3–6]

PCMHs may be particularly beneficial to cancer patients with chronic conditions such as diabetes, hypertension, and hyperlipidemia. Nearly 40% of cancer patients have at least one

chronic condition.[7] After a cancer diagnosis, these patients not only experience worse outcomes and higher healthcare costs,[8,9] but their adherence to chronic medications often decreases.[10–13] Non-metastatic cancer survivors are more likely to die of other causes, such as cardiovascular disease, than of cancer,[7] highlighting the importance of long term adherence to medications for conditions comorbid to cancer diagnoses. Additionally, cancer survivors with diabetes live on average 5 years less than those without diabetes,[14] further illustrating the importance of continuous primary care. Due to the emphasis on care coordination, PCMHs are well-positioned to ensure optimal management of these patients' non-cancer health needs.[15–17]

While some studies have described how PCMHs influence cancer care quality, medical expenditures, and healthcare utilization,[18–22] none have described how PCMHs affect chronic adherence for cancer patients. In this study, we had two primary objectives. First, we evaluated the impact of a cancer diagnosis on chronic medication adherence for Medicaid patients with hyperlipidemia, hypertension, and diabetes, three of the most prevalent chronic conditions among cancer patients,[23] compared to matched non-cancer controls. Second, we evaluated whether PCMHs membership modified the impact of being diagnosed with cancer on medication adherence for Medicaid patients. We also examined medical expenditures and healthcare utilization outcomes. We focused specifically on Medicaid patients, since this population has a higher rate of chronic conditions compared to the total US population[24] and because PCMHs are commonly used to improve care coordination in these low-income beneficiaries.[18,25]

## METHODS

### Setting

In 1998, North Carolina piloted their PCMH program, the Community Care of North Carolina (CCNC), in 24 counties. This program was specifically developed to improve primary care by enrolling Medicaid patients into PCMHs. To be part of the CCNC program, providers must meet certain quality standards (see Supplemental Figure 1). Medicaid patients who enroll in CCNC can select or be assigned a CCNC provider, who receives per member per month payments for care coordination.[25] Patients who do not enroll in CCNC receive traditional fee-for-service healthcare. Currently, CCNC includes 14 networks that cover all 100 counties in North Carolina and serves 1.7 million patients.[26] In 2019, CCNC was estimated to have decreased Medicaid expenditures by $279 million.[26]

### Data and Study Population

We used data provided by the Cancer Information and Population Health Resource consisting of linked cancer registry, Medicaid, and Medicare claims data (the latter used to track dual enrollees' claims) from North Carolina, including patient demographics, tumor information, and claims for prescription drugs and emergency, inpatient, and outpatient services.[27] Our study population comprised Medicaid enrollees (≥18 years old) diagnosed between 2004–2010 with breast, colorectal, or non-small cell lung cancer who had at least one chronic condition (i.e., hyperlipidemia, hypertension, and/or diabetes mellitus) at the time of their index cancer diagnosis date. We excluded individuals diagnosed with metastatic

disease, in the same month as death, or at death or autopsy. To be included, individuals had to be enrolled in Medicaid or dually enrolled in Medicaid and Medicare for 12 months before, through 12 months after, their index cancer diagnosis date (Supplemental Figure 2).

We created 3 distinct cohorts, one for each chronic condition, although the same patient could be represented in multiple cohorts (Figure 1). For the diabetes and hyperlipidemia cohorts, patients had to have a diagnosis code or a prescription drug claim for an oral medication for that condition from −12 to −6 months before their cancer diagnosis. For the hypertension cohort, patients were required to have both a diagnosis code and a prescription drug claim since many antihypertensives can be used to treat other conditions.

For each cancer patient (in each chronic condition cohort), we identified all potential individuals with the same chronic condition but without a diagnosis of cancer by using one-to-one matching on age (using 5-year age groups), sex, race (Non-Hispanic White, Non-Hispanic Black, Hispanic, Unknown/Other), and insurance enrollment (Medicaid only, Medicare/Medicaid dual) (Supplemental Table 1). Non-cancer comparison patients were selected with replacement and assigned a ‘pseudo-diagnosis’ index date, based on the matched cancer patient’s diagnosis date.

## Dependent Variables

All outcomes were measured in 6-month time periods from 6-months before through 12 months after the index diagnosis (or pseudo-diagnosis) date, resulting in three consecutive time periods. These phases were defined according to the cancer patients’ phases of care, specifically: (a) pre-diagnosis (months −5 to 0), (b) initial post-diagnosis (months 1 to 6), and (c) continuing (months 7 to 12).

Our primary outcome was adherence to medications indicated for each chronic condition defined as the proportion of days covered (PDC), or the number of days covered by a prescription drug divided by the total number of days in the observation period. The PDC was measured for each chronic condition examined within each cohort. To calculate the PDC, we followed the requirements outlined in the Centers for Medicare & Medicaid Services (CMS) Star Ratings program, which accounts for potential mismeasurement of medication exposure during hospitalizations and skilled nursing facility stays by removing these days from the denominator (i.e. total number of days in the observation period) and carrying forward any days’ supply which overlapped with a hospital or skilled nursing facility stay.[28] Switching within and across drug classes was allowed (i.e., a patient was considered adherent if they had, in their possession, any drug to treat the chronic condition). For the diabetes cohort, we excluded patients with claims for insulin during the study period.[28] For primary analysis, we employed a continuous measure of PDC.

We examined three secondary outcomes: total medical expenditures, and two dichotomized measures of healthcare utilization, indicating any inpatient hospitalization or any ED use. For the expenditure measure, we adjusted for inflation using the Medicare Economic Index and calculated into 2010 dollars.

### Independent Variables

The key independent variable of interest was PCMH membership, a binary indicator of whether patients were enrolled for the entire period corresponding to the pre-diagnosis, initial post-diagnosis, and continuing phases of care, from month −5 to 12. PCMH membership was determined through a monthly payment to PCMH providers or to the affiliated PCMH network.

All models were adjusted for age, sex, race/ethnicity, insurance enrollment, year of index diagnosis, cancer type, cancer stage, comorbidity index (based upon an adapted index combining the Charlson and Elixhauser measures[29]), and number of chronic conditions of interest.

### Statistical Analysis

We summarized patient characteristics for each chronic condition cohort. We examined differences in mean PDC, expenditures, and healthcare utilization by chronic condition and phase of care. Using difference-in-difference methods, we examined how medication adherence varied over time among cancer and non-cancer patients. In other words, we evaluated the effect of a cancer diagnosis on changes in our outcomes from the pre-diagnosis phase (referent period) to the initial post-diagnosis and continuing phases. Second, we compared changes in medication adherence over time between cancer and non-cancer patients by PCMH membership using a differences-in-differences-in-differences approach. Analyses were conducted separately for each chronic condition cohort. Accounting for the matching, we used generalized estimating equations analysis with an exchangeable working correlation matrix. All statistical analyses were performed using SAS version 9.4 (Cary, NC). This study was approved by the University of North Carolina at Chapel Hill Institutional Review Board.

## RESULTS

We included, respectively, 688, 1,445, and 955 cancer patients in our diabetes, hypertension, and hyperlipidemia cohorts (Table 1). Across cohorts, most cancer patients were between ages 70–79 (49%−52%), female (74%−76%), white (53%−61%), dually enrolled (76% −83%), and had two or more comorbidities (48%−50%). Approximately 20% of each cohort was in a PCMH.

### Changes in cancer patients' medication adherence

We compared changes in outcomes by chronic condition and phase of care between the cancer patients and their matched non-cancer comparators (Figure 2A–D). Across all phases, medication adherence was highest among cancer and non-cancer patients with hypertension (range: 86%−91%) and lowest among cancer and non-cancer patients with hyperlipidemia (range: 58%−74%). For hyperlipidemia patients diagnosed with cancer, statin adherence decreased significantly between the pre-diagnosis phase and initial post-diagnosis phase (Beta:−7.94, 95%CI:−10.27, −5.69, p=0.0004) as well as between the pre-diagnosis and continuing phases (Beta:−10.27, 95%CI:−13.36, −7.18, p<0.0001), compared to non-cancer patients (Supplemental Table 2). Among patients with diabetes or hypertension, declines in

adherence over time were similar between cancer and non-cancer patients. In two sensitivity analyses, we adjusted for number of primary care visits and also dichotomized PDC at ≥80% medication adherent; in both instances, results did not change.

### Changes in cancer patients' expenditures and healthcare utilization

Across all chronic conditions, cancer patients experienced significant increases in their medical expenditures compared to their matched non-cancer controls (difference-in-difference estimates ranging from $38,038-$39,166 in the initial post-diagnosis phase and from $4,388-$8,476 in the continuing phase). Inpatient hospitalizations, across chronic condition cohorts, occurred more often for cancer patients in the pre-diagnosis phase (range: 40%−45%) than for non-cancer patients (range: 24%−30%). Increases in the likelihood of hospitalization in the initial post-diagnosis phase versus the pre-diagnosis phase were significantly larger for cancer patients compared to non-cancer patients across all chronic condition cohorts. However, when comparing the continuing phase to the pre-diagnosis phase, cancer patients' likelihood of hospitalizations declined across all chronic condition cohorts. Declines in the likelihood of an ED visit in the initial post-diagnosis or continuing phase versus the pre-diagnosis phase were similar between cancer and non-cancer patients with one exception: for cancers patients with hypertension, the likelihood of ED visits decreased in the continuing phase compared with the matched non-cancer cohort (Odds Ratio (OR):0.61, 95%CI: 0.49, 0.74, $p<0.0001$).

### Differential effect of PCMH on cancer patients' medication adherence

In Table 2, we stratified the difference-in-difference comparisons of changes over time in medication adherence between cancer and non-cancer patients by PCMH membership (see Supplemental Figure 3 for unadjusted PDC values by PCMH membership). In examining medication adherence, only among non-PCMH cancer patients with hyperlipidemia did medication adherence decrease significantly, between the pre-diagnosis and initial post-diagnosis phase (Beta:−8.79, 95%CI:−11.40, −6.18, $p<0.0001$) as well as between the pre-diagnosis and continuing phase (Beta:−11.28, 95%CI:−14.75, −7.81, $p<0.0001$), compared to non-PCMH non-cancer patients. However, changes in medication adherence over time between cancer and non-cancer patients were not significantly different across PCMH status for any of the chronic condition cohorts (third panel of Table 2).

### Differential effect of PCMH on cancer patients' expenditures and healthcare utilization

Among our secondary outcomes, we found a few notable differences between PCMH and non-PCMH cancer patients over time (Table 3). Across chronic condition cohorts, both PCMH and non-PCMH cancer patients experienced significant increases in their total medical expenditures compared to, respectively, PCMH and non-PCMH non-cancer patients. PCMH cancer patients experienced a $24,358-$38,327 increase in costs from the pre-diagnosis to the initial post-diagnosis phase compared to PCMH non-cancer patients. However, these increases in medical spending were consistently smaller for PCMH cancer patients than non-PCMH cancer patients (relative to non-cancer patients), particularly in the diabetes cohort (Beta:-$16,759, 95%CI: -$26,469, -$7,048, $p=0.0007$).

PCMH and non-PCMH cancer patients also experienced significant increases in the likelihood of being hospitalized between the pre-diagnosis and initial post-diagnosis phase relative to non-cancer patients. In the diabetes cohort, increases in hospitalization rates were smaller among PCMH cancer patients than non-PCMH cancer patients but not statistically significant (OR:0.73, 95%CI:0.27, 1.92, p=0.52). In the hypertension and hyperlipidemia cohorts, increases in inpatient hospitalization rates were larger for PCMH cancer patients than for non-PCMH cancer patients (relative to non-cancer patients), although only significantly higher in the hypertension cohort (OR:3.14, 95%CI 1.66, 5.92, p=0.0004). Lastly, PCMH and non-PCMH cancer patients experienced no statistically significant changes in ED, both between the initial post-diagnosis and pre-diagnosis phases and between the continuing and pre-diagnosis phases.

## DISCUSSION

We compared patterns of medication adherence, medical expenditures, and healthcare utilization for Medicaid enrollees with chronic conditions to matched non-cancer comparators over time and then assessed the impact of PCMHs on these outcomes. Results showed that patients with hyperlipidemia were particularly vulnerable to lower medication adherence after a cancer diagnosis. Cancer patients were likely to experience dramatic increases in their total medical expenditures and inpatient hospitalizations in the first 6 months after their diagnosis relative to non-cancer patients. There was some evidence that increases in medical expenditures and ED use were smaller among PCMH cancer patients than non-PCMH cancer patients (relative to non-cancer patients). However, increases in rates of inpatient hospitalizations among cancer patients relative to non-cancer patients were higher among PCMH patients than non-PCMH patients.

Similar to previous studies, Medicaid patients with hyperlipidemia had the lowest medication adherence overall.[6,30,31] A few factors may account for low statin adherence. First, diabetic and hypertensive patients can, respectively, check their blood glucose and blood pressure at home, and may experience symptoms if blood pressure or blood glucose levels rise, providing reinforcement for adherence. In contrast, the impact of medication on cholesterol levels is assessed by serologic lab tests rather than during physical exams or by self-monitoring. Patients often receive their results several days later and may not discuss their results with clinicians. Additionally, it is unlikely that patients will feel any negative symptoms from statin non-adherence.

We also found that statin adherence declined dramatically after a cancer diagnosis whereas anti-hypertensive and anti-diabetic adherence remained relatively stable compared to non-cancer patients. For patients newly-diagnosed with cancer, providers may be less concerned about statin non-adherence since benefits from taking statins are not immediate and accumulate over time; a brief respite from taking statins is ultimately not detrimental to cancer patients' overall health and allows the provider and patient to focus on treating the cancer and cancer-related symptoms. In contrast, for cancer patients with diabetes, close management of their glucose level is particularly important since certain chemotherapies and the use of steroids can cause abnormal blood glucose levels. Thus, particularly in the context of strained financial resources, patients and providers may rank statins as a lower priority.

For cancer patients with hypertension, blood pressure would also be likely to be closely monitored by providers since some medications can lead to adverse symptoms. In sum, particularly in the context of strained financial resources, cancer patients and their providers may rank statins as a lower priority, since it does not lead to adverse symptoms and is not detrimental to their cancer treatment whereas monitoring of diabetes and hypertension may influence cancer patients' quality of life. In future studies, qualitative research identifying the reasons for reductions in statin adherence and maintenance of anti-diabetic and anti-hypertensive medication adherence would be helpful.

We found no evidence that changes in chronic medication adherence for cancer patients relative to non-cancer patients were different for patients in PCMHs using data from 2004–2010. To fully optimize medication adherence, studies have advocated that pharmacists be integrated into PCMH models,[32–34] and it was not until 2007 that pharmacists were included in CCNC networks.[35] In a study using data from 2008–2010, CCNC patients with multiple chronic conditions exhibited higher adherence to medications for depression, hyperlipidemia, hypertension, and diabetes compared non-CCNC patients.[6] Other studies have shown that incorporating pharmacists into primary care and establishing stronger collaborations between pharmacists and providers is both effective and cost-effective in improving medication adherence.[36–38]

Increases in medical expenditures among cancer patients, relative to non-cancer patients, were significantly lower for PCMH diabetes patients versus non-PCMH diabetes patients. This finding differs from previous analyses among CCNC cancer patients in North Carolina; a study using data from 2003–2007 found that CCNC enrollment was associated with increased monthly expenditures for newly diagnosed breast cancer patients.[20] However, this previous analysis employed person-fixed effects. While their approach addresses selection bias issues associated with PCMH enrollment, the cost estimates were based on only women who joined CCNC during the study period or were not consistently enrolled in CCNC.[20] These increased expenditures could be attributed to patients having unmet health needs that they are then able to address once enrolled in CCNC. In contrast, our estimates are based on a broader cancer cohort of both men and women continuously enrolled in CCNC, even prior to their cancer diagnosis.

Perhaps surprisingly, increases in the likelihood of hospitalization for cancer patients relative to non-cancer patients with hypertension were higher among PCMH patients than non-PCMH patients. Previous CCNC studies among breast cancer patients found that CCNC enrollment had no effect on the likelihood of being hospitalized[20] and that CCNC enrollment was associated with fewer inpatient hospitalizations for chemotherapy-related adverse events.[19] Unlike a previous study limited to women enrolled solely in Medicaid, our analysis included both men and women and Medicare/Medicaid dual enrollees. In 2005, CCNC participated in a CMS demonstration project in which they broadened CCNC's role in managing the care of dual enrollees and at-risk Medicare patients,[39] both of which represent vulnerable populations of low-income, aged, or disabled individuals. Consequently, patients with the worst comorbidities may have been channeled into PCMHs prior to being diagnosed with cancer. These patients would be at higher risk of poor

outcomes during their cancer treatment, which may have increased their likelihood of being hospitalized compared to non-PCMH patients.

This study is not without limitations. First, we measured medication adherence using claims data rather than observing actual medication use; filled prescriptions do not necessarily mean they were consumed, but this is a common approach in the literature used to understand medication use.[11–13] Second, we required 12 months of continuous enrollment after diagnosis, potentially biasing our analytic sample since Medicaid patients with discontinuous enrollment (including patients who may have died) are often less healthy and have worse outcomes.[40] Third, our findings may be specific to North Carolina. However, CCNC has been heralded as a national model for enhancing care coordination, leading states to create PCMH programs based on CCNC principles.[41] Evaluating CCNC may provide valuable insight to state policymakers designing and evaluating PCMH programs. Lastly, similar to previous analyses,[18–20] we could not fully control for selection into CCNC. While we controlled for observable covariates in our model, unobservable factors such as patient's perceived health risk or health beliefs that may motivate patients to enroll in PCMH may be responsible for the relationships observed.

This study provides valuable insight into chronic medication adherence and healthcare utilization in a low-income population with and without cancer. After a cancer diagnosis (regardless of PCMH membership), patients with hyperlipidemia have significantly lower adherence to hyperlipidemia medications, relative to similarly matched patients without cancer. Additionally, across chronic condition cohorts, medical costs and hospitalizations increased substantially for newly diagnosed cancer patients compared to those not diagnosed with cancer. Given the demonstrated potential for low-income cancer patients with chronic conditions to have worse adherence to their chronic medications, higher costs, and higher healthcare utilization around the time of cancer diagnosis, future studies should examine a variety of approaches that can help mitigate the multidimensional burden of cancer in low-income populations.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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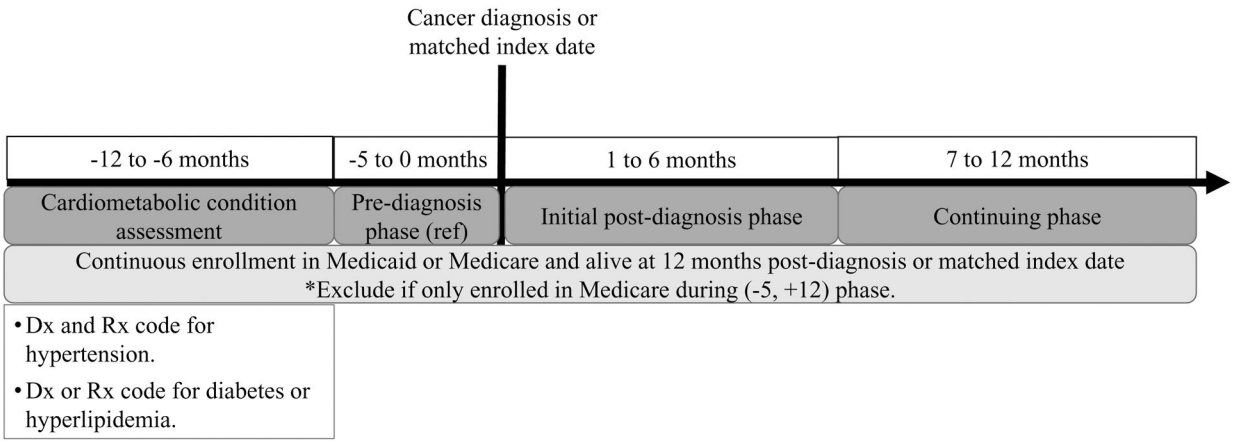
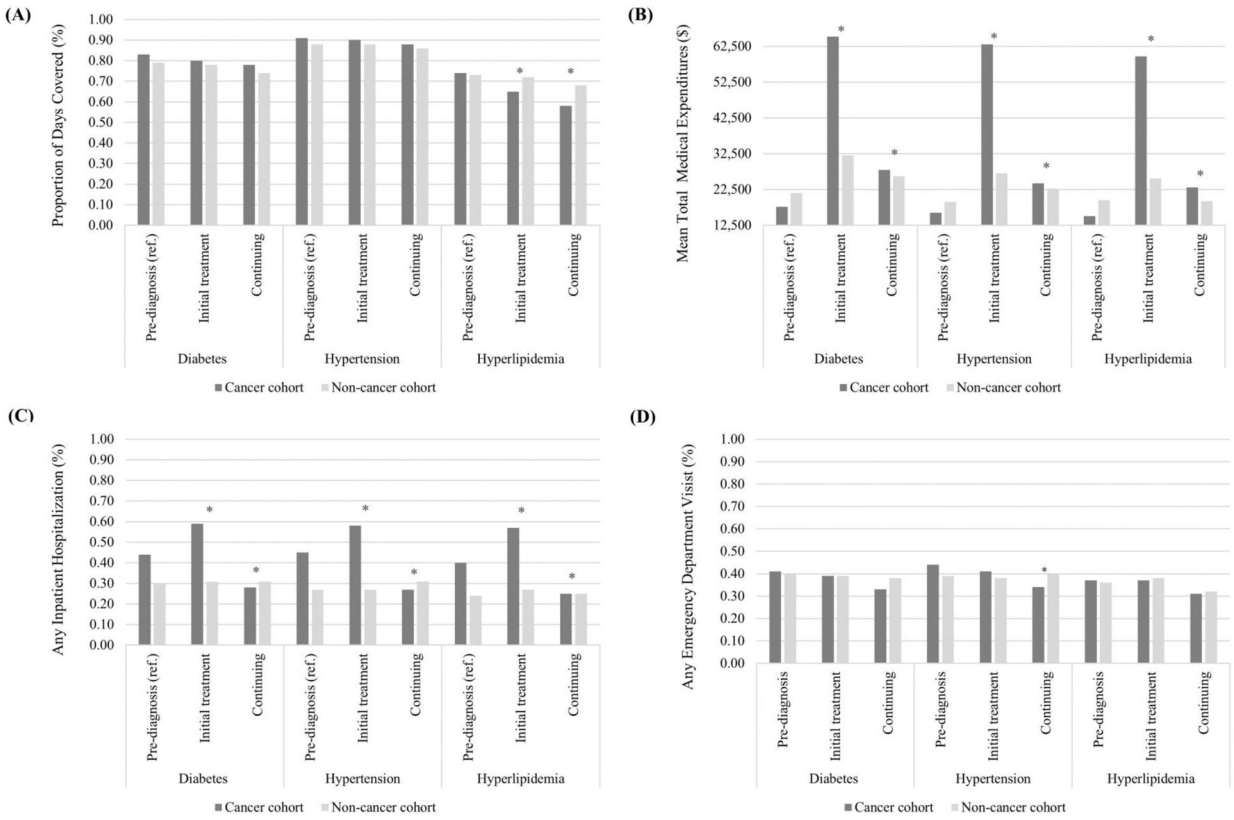



**Figure 1.**
Diagram of Study Design.




**Figures 2A-D. Outcomes by chronic condition and phase of care of Medicaid enrollees.**

Figures show (A) proportion of days covered, (B) medical expenditures, (C) inpatient hospitalizations, and emergency department visits by chronic condition and phase of care for Medicaid enrollees. In our diabetes, hypertension, and hyperlipidemia cohorts, 688, 1,445, and 955 cancer patients, respectively, were included. * indicates statistically significant ($p<0.05$) changes in the outcomes over time (i.e. from the pre-diagnosis phase (referent period) to the initial post-diagnosis and continuing phases) between cancer and non-cancer patients using difference-in-difference methods. All models adjusted for age, sex, race/ethnicity, insurance enrollment, year of diagnosis, cancer type, cancer stage, comorbidity index, and number of chronic conditions of interest.

**Table 1.**

Characteristics of Medicaid cancer patients

| | Diabetes (N=688) | | Hypertension (N=1,445) | | Hyperlipidemia (N=955) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Age(mean, std) | 67.7 | 10.4 | 69.6 | 11.0 | 68.2 | 10.1 |
| 18–59 years | 9 | 1.3 | 17 | 1.2 | 9 | 0.9 |
| 60–69 years | 245 | 35.6 | 442 | 30.6 | 314 | 32.9 |
| 70–79 years | 349 | 50.7 | 708 | 49.0 | 500 | 52.4 |
| ≥80 years | 85 | 12.4 | 278 | 19.2 | 132 | 13.8 |
| Sex | | | | | | |
| Female | 509 | 74.0 | 1,093 | 75.6 | 704 | 73.7 |
| Male | 179 | 26.0 | 352 | 24.4 | 251 | 26.3 |
| Race/ethnicity | | | | | | |
| Non-Hispanic white | 365 | 53.1 | 772 | 53.4 | 580 | 60.7 |
| Non-Hispanic black | 289 | 42.0 | 575 | 39.8 | 319 | 33.4 |
| Other | 34 | 4.9 | 98 | 6.8 | 56 | 5.9 |
| Insurance enrollment | | | | | | |
| Medicaid only | 164 | 23.8 | 244 | 16.9 | 215 | 22.5 |
| Medicaid/Medicare | 524 | 76.2 | 1,201 | 83.1 | 740 | 77.5 |
| Cancer | | | | | | |
| Breast | 178 | 25.9 | 376 | 26.0 | 230 | 24.1 |
| Colorectal | 318 | 46.2 | 604 | 41.8 | 379 | 39.7 |
| Lung | 192 | 27.9 | 465 | 32.2 | 346 | 36.2 |
| Comorbidity index | | | | | | |
| 0 | 196 | 28.5 | 253 | 17.5 | 262 | 27.4 |
| 1 | 151 | 22.0 | 395 | 27.3 | 238 | 24.9 |
| 2+ | 341 | 49.6 | 797 | 55.2 | 455 | 47.6 |
| # of chronic conditions | | | | | | |
| 1 | 95 | 13.8 | 548 | 37.9 | 167 | 17.5 |
| 2 | 288 | 41.9 | 589 | 40.8 | 481 | 50.4 |
| 3 | 305 | 44.3 | 308 | 21.3 | 307 | 32.2 |

Note: Cancer patients diagnosed between 2004–2010. Comorbidity index calculated during months (−12, −6).

**Table 2.**

Differential estimates of PCMH enrollment for changes in mean PDC by chronic condition and phase of care among Medicaid enrollees

| | Estimate (95% CI) | |
|---|---|---|
| | Initial Post-diagnosis (vs. Pre-diagnosis) | Continuing (vs. Pre-diagnosis) |
| **DD among PCMH enrollees** | | |
| Diabetes mellitus | 1.48 (−4.98, 7.93) | −0.46 (−7.63, 6.71) |
| Hypertension | 1.94 (−0.76, 4.64) | 2.12 (−1.71, 5.94) |
| Hyperlipidemia | −4.55 (−9.97, 0.87) | −5.63 (−12.86, 1.60) |
| **DD among Non-PCMH enrollees** | | |
| Diabetes mellitus | −2.43 (−5.00, 0.14) | 0.01 (−3.28, 3.30) |
| Hypertension | −0.64 (−2.13, 0.84) | −0.67 (−2.77, 1.43) |
| Hyperlipidemia | −8.79** (−11.40, −6.18) | −11.28** (−14.75, −7.81) |
| **Differential effect (PCMH - Non-PCMH)** | | |
| Diabetes mellitus | 3.91 (−3.04, 10.86) | −0.47 (−8.42, 7.47) |
| Hypertension | 2.59 (−0.48, 5.65) | 2.78 (−1.62, 7.20) |
| Hyperlipidemia | 4.24 (−1.76, 10.24) | 5.65 (−2.39, 13.69) |

Note: PCMH, patient-centered medical home; PDC, proportion of days covered; CI, confidence intervals; DD, difference-in-difference comparing change over time between cancer and non-cancer patients. Analyses were conducted using generalized linear regression models, accounting for matching between cancer and non-cancer patients. All models adjusted for age, sex, race/ethnicity, insurance enrollment, year of diagnosis, cancer type, cancer stage, comorbidity index, and number of chronic conditions of interest. The first two panels show the PCMH stratified DD comparisons of changes over time in PDC between cancer and non-cancer patients. The third panel shows the difference-in-difference-in-difference comparisons in PDC over time between PCMH and non-PCMH cancer patients (relative to non-cancer patients).

** $p<0.01$

**Table 3.**

Differential estimates of PCMH for changes expenditures and healthcare utilization by chronic condition and phase of care

| | Expenditures ($) Estimate (95% CI) | | Any Inpatient OR (95% CI) | | Any ED OR (95% CI) | |
|---|---|---|---|---|---|---|
| | Initial Post-diagnosis (vs. Pre-diagnosis) | Continuing (vs. Pre-diagnosis) | Initial Post-diagnosis (vs. Pre-diagnosis) | Continuing (vs. Pre-diagnosis) | Initial Post-diagnosis (vs. Pre-diagnosis) | Continuing (vs. Pre-diagnosis) |
| **DD among PCMH enrollees** | | | | | | |
| Diabetes mellitus | 24,358** (16,277, 32,438) | 5,507 (−1,235, 12,248) | 2.32 (1.07, 5.03) | 0.33* (0.15, 0.71) | 0.56 (0.23, 1.37) | 1.55 (0.69, 3.49) |
| Hypertension | 38,327** (33,637, 43,016) | 4,732* (667, 8,797) | 4.76** (2.61, 8.68) | 0.44** (0.25, 0.79) | 1.09 (0.64, 1.87) | 0.79 (0.46, 1.36) |
| Hyperlipidemia | 34,355** (28,434, 40,277) | 5,455* (755, 10,156) | 2.16* (1.00, 4.67) | 0.32** (0.15, 0.68) | 0.48 (0.24, 0.97) | 1.03 (0.49, 2.18) |
| **DD among Non-PCMH enrollees** | | | | | | |
| Diabetes mellitus | 41,116** (35,783, 46,449) | 6,152** (1,921, 10,382) | 1.76** (1.26, 2.45) | 0.46** (0.34, 0.63) | 1.08 (0.79, 1.47) | 0.67* (0.49, 0.92) |
| Hypertension | 39,833** (36,204, 43,463) | 4,479** (1,578, 7,379) | 1.52** (1.20, 1.92) | 0.36** (0.28, 0.45) | 0.87 (0.71, 1.07) | 0.58** (0.46, 0.72) |
| Hyperlipidemia | 40,170** (35,688, 44,652) | 8,851** (5,317, 12,386) | 1.59* (1.17, 2.15) | 0.46** (0.34, 0.63) | 0.96 (0.75, 1.24) | 0.84 (0.64, 1.10) |
| **Differential effect (PCMH - Non-PCMH)** | | | | | | |
| Diabetes mellitus | −16,759** (−26,469, −7,048) | −645 (−8,529, 7,239) | 0.73 (0.27, 1.92) | 0.72 (0.28, 1.93) | 0.52 (0.20, 1.33) | 2.31 (0.98, 5.47) |
| Hypertension | −1,507 (−7,452, 4,438) | 254 (−4,773, 5,280) | 3.14** (1.66, 5.92) | 1.24 (0.66, 2.32) | 1.26 (0.71, 2.23) | 1.38 (0.77, 2.46) |
| Hyperlipidemia | −5,815 (−13,490, 1,861) | −3,396 (−9,402, 2,610) | 1.46 (0.63, 3.37) | 0.71 (0.31, 1.66) | 0.50 (0.23, 1.01) | 1.23 (0.56, 2.73) |

Note: PCMH, patient-centered medical home; OR, odds ratios; CI, confidence intervals; ED, emergency department; DD, difference-in-difference comparing change over time between cancer and non-cancer patients. Analyses conducted are described in Table 2 notes.

** p<0.01,

* p<0.05