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Steven Chen Date

Association between Patient-Centered Medical Home (PCMH) Care Concordance and Cancer Screening Use in Federally Qualified Health Centers (FQHCs)

By

Steven Chen
Master of Science in Public Health

Department of Health Policy and Management

_____
Adam S. Wilk, PhD
Committee Chair

_____
Joseph Lipscomb, PhD
Committee Member

_____
Silke von Esenwein, PhD
Committee Member

_____
Jon Wollenzien, Jr., DBA
Committee Member

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By

Steven Chen
BA, BS
University of Maryland
2017

Thesis Committee Chair: Adam S. Wilk, PhD

An abstract submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

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By: Steven Chen

Cancer is a leading cause of morbidity and mortality in the United States. Federally qualified health centers (FQHCs) are a critical component of the health care safety net and expand access to preventive services, including cancer screening, for underserved populations. In recent years, FQHCs have demonstrated substantial interest in the patient-centered medical home (PCMH) model, a widely-promoted approach to restructure primary care delivery in alignment with five domains: (1) team-based, comprehensive care, (2) care coordination and integration, (3) patient-centered orientation, (4) enhanced access aligned to patient preferences, and (5) continuous quality improvement. The literature to date has suggested that health center patients receiving PCMH-concordant care are more likely to receive recommended cervical and colorectal cancer screenings; however, these studies leveraged health center-reported estimates of PCMH care concordance and cancer screening use, which may be inaccurate due to measurement error. In addition, no study has provided nationally representative estimates of breast cancer screening utilization at FQHCs. This study uses national, patient-reported data (2014 Health Center Patient Survey) to investigate whether PCMH care concordance at FQHCs is associated with breast, cervical, and colorectal cancer screening use. Logistic regression models, adjusted to account for the complex survey design elements of the data, offer evidence of a positive association between PCMH care concordance and cervical cancer screening, mixed evidence regarding a possible association between PCMH concordance and colorectal cancer screening, and no evidence of an association between PCMH concordance and breast cancer screening. These findings underscore the potential for the PCMH model to improve cancer screening use in health centers, and highlight the need for additional research using patient-reported data into how PCMH practice transformation may facilitate improved cancer screening rates in primary care practices whose patients are primarily from low-income, medically underserved populations.

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Chapter 1: Introduction

Cancer remains a major cause of mortality and morbidity in the United States [1]. While cancer screening can reduce the burden of cancer through early detection and treatment, screening rates in the United States remain lower than desired [2]. In particular, cancer screening use is substantially lower among persons of low socioeconomic status, minority race/ethnicity, and low health care access (including medically underserved and uninsured populations) [3].

Federally qualified health centers (FQHCs) are a critical component of the health care safety net. Providing services to more than 28 million patients annually, FQHCs primarily serve low-income and medically underserved populations by offering health care services on a sliding scale basis to persons with incomes at or under 200% of the federal poverty line ($52,400 for a family of four) [4, 5]. In the past decade, FQHCs have demonstrated significant interest in the patient-centered medical home (PCMH) model [6]. The central objective of the PCMH model is to restructure primary care delivery and empower primary care physicians to facilitate accessible, coordinated, comprehensive, and patient-centered care [7]. As such, the PCMH model may be a potential pathway for health centers to improve care quality, including cancer screening use [8].

The extant literature suggests a positive association between PCMH practice transformation and cancer screening use [9-14]. However, the literature to date is mixed regarding the effects of PCMH practice transformation and cancer screening use among health center patients. While some studies suggest improvements in breast, cervical, and colorectal cancer screening rates associated with FQHC PCMH practice transformation, other studies find null results [15-20]. However, previous research investigating the association between FQHC PCMH practice transformation and cancer screening use have

relied on health center-reported data, which may be incomplete or inaccurate. No study has used patient-reported data, which addresses limitations with health center-level data, to identify the association between PCMH care concordance and cancer screening use at health centers.

The objective of this study is to use the most recent, patient-level data to investigate the effects of PCMH care concordance on recommended cancer screening use among patients receiving care at FQHCs. Consistent with previous literature, I hypothesize that patients who receive PCMH-concordant care are more likely to receive recommended breast, cervical, and colorectal cancer screening services. The study leverages data from the Health Center Patient Survey and employs logistic regression models adjusted for the complex survey design elements of the dataset. Additional supplemental analysis compares the estimates using patient-level data with those using health center-level data to describe the importance of including individual-level confounders in analyses of PCMH implementation and preventive health care utilization.

Findings from this study can provide additional evidence for using delivery system interventions to improve cancer screening use among FQHCs and reduce cancer disparities. Indeed, public health officials have stressed the need for further research on organizational and management interventions to improve cancer screening use among populations experiencing health disparities, as existing evidence for their effectiveness or adoption is insufficient or of low strength [21]. Policymakers and health care administrators can ultimately leverage this research to inform potential strategies for increasing cancer screening use among low-income populations and evaluate whether the

PCMH model is the most appropriate or effective approach to achieving improvements in desired care outcomes.

Chapter 2: Literature Review

A. Cancer Screening and Federally Qualified Health Centers (FQHCs)

Cancer is the second leading cause of death and remains a significant public health issue in the United States [1, 2]. The development of cancer screening technologies and organized screening programs have resulted in significant decreases in cancer incidence and mortality [22-28]. The US Preventive Services Task Force (USPSTF) and the American Cancer Society (ACS) strongly recommend regular screening for breast, cervical, and colorectal cancer [29-31]. However, disparities in cancer incidence, mortality, and screening persist across income and insurance status. In particular, cancer screening rates among uninsured and low-income populations remain lower than those among insured and higher-income populations, leading to delayed diagnosis and increased mortality [32-34].

With their mission to serve low-income and underserved populations, federally qualified health centers (FQHCs) are a critical component of the health care safety net and provide health care to more than 28 million patients annually [4]. FQHCs are health care providers that receive federal grant funding under Section 330 of the Public Health Service Act and provide services to traditionally underserved populations [35].[1] FQHCs are required to be located in medically underserved areas, primarily serve groups who have historically experienced health disparities, and offer health care services to those with incomes at or under 200% of the federal poverty level on a sliding fee scale [35].

[1] Some health centers, FQHC look-alikes, do not receive federal grant funding under Section 330 of the Public Health Service Act but are eligible to apply for reimbursement under FQHC Medicare and Medicaid payment methodologies. Hereinafter, "FQHCs" and "health centers" refer to only those health centers that receive federal grant funding and do not include FQHC look-alikes.

Given their provision of affordable and accessible health care services, FQHCs play a major role in expanding access to and use of cancer screening services to underserved populations [36-38]. Uninsured, low-income, and minority health center patients are more likely to receive recommended breast, cervical, and colorectal cancer screening than similar patients not receiving care at health centers [4]. Even so, only 56% of health center patients receive appropriate cervical cancer screening and 42% receive appropriate colorectal cancer screening, rates lower than the general population's [39]. No nationally representative estimates have been published for the rate of breast cancer screening among health center patients. In comparison, among the US population, 72% receive appropriate breast cancer screening, 81% receive appropriate cervical cancer screening, and 63% receive appropriate colorectal cancer screening [40].

B. The Patient-Centered Medical Home (PCMH)

The patient-centered medical home (PCMH) is a widely-promoted approach to restructure primary care delivery. PCMHs are promoted as a means to empower primary care providers to facilitate accessible, continuous, comprehensive, and coordinated patient care [7]. First introduced in 1967, the idea rose to prominence in 2007 when four leading primary care associations, the American Academy of Family Physicians (AAFP), American Academy of Pediatrics (AAP), American College of Physicians (ACP), and American Osteopathic Association (AOA), jointly developed a set of principles to define the medical home. Now, the medical home refers to primary care sites that feature: (1) team-based, comprehensive care, (2) care coordination and integration, (3) patient-centered orientation, (4) enhanced access aligned to patient preferences, and (5) continuous quality and safety monitoring and improvement [41, 42].

PCMHs are recognized, certified, and/or accredited by third party organizations such as the National Committee for Quality Assurance (NCQA), The Joint Commission, the Accreditation Association for Ambulatory Health Care (AAAHC), and others. These organizations define PCMH criteria and offer PCMH recognition, certification, or accreditation based on achievement of those criteria. Each third party organization may offer on-site and/or remote guidance to support primary care practices interested in PCMH practice transformation. To achieve PCMH recognition, primary care practices review the requirements from a specific accreditation organization, select and implement changes to align the practice with the PCMH criteria, and submit documentation required for accreditation.

The NCQA operates the largest PCMH recognition program; as of June 2019, approximately 14,000 primary care practice sites have achieved NCQA medical home recognition and 86% of practice sites recognized as a PCMH use the NCQA recognition program [43]. Organizations with more than one primary care practice site apply for PCMH recognition for individual sites. The NCQA's PCMH recognition program requires primary care practice sites to meet 40 core criteria across six central concepts of (1) Team-Based Care and Practice Transformation; (2) Knowing and Managing Your Patients; (3) Patient-Centered Access and Continuity; (4) Care Management and Support; (5) Care Coordination and Care Transitions; and (6) Performance Measurement and Quality Improvement. In addition, practices must also earn 25 out of 84 credits in elective criteria spanning five of the six concepts [44]. A brief description of each concept is given in Table 1 [44].

Table 1: NCQA PCMH Concepts

Concept	Description
Team-Based Care and Practice Organization	The practice commits to PCMH practice transformation, identifies key internal and external stakeholders, and organizes its staff to promote sharing of patient information and care needs and encourage efficient practice workflow.
Knowing and Managing Your Patients	The practice captures and analyzes information about the patients and communities it serves, and uses the information to deliver evidence-based, culturally appropriate health interventions.
Patient-Centered Access and Continuity	The practice enhances patient access by providing access to same-day and after-hours appointment availability or clinical advice in alignment with patient needs.
Care Management and Support	The practice assesses individual and population-level patient needs and supports patients who may benefit from care management.
Care Coordination and Care Transitions	The practice proactively tracks diagnostic tests, referrals to specialists, and care transitions to other health care facilities.
Performance Measurement and Quality Improvement	The practice measures clinical quality, efficiency, and patient experience and engages in quality improvement efforts.

Numerous researchers have investigated how the PCMH model affects health care quality, utilization, outcomes, and experiences in different settings [45-52]. Systematic reviews find that the PCMH model is consistently associated with increased preventive services use, improved chronic disease management, and decreased emergency department use [9-11]. More recently, Berk-Clark et al. conducted a systematic review examining PCMH model interventions for low-income patient populations; they concluded that low-income patients who receive care at practices recognized as PCMHs had improved clinical outcomes and quality of care compared with low-income patients who receive care at practices not recognized as PCMHs [53].

However, the systematic reviews of PCMH interventions note several challenges with synthesizing findings from published PCMH studies. First, studies of PCMH

practice transformation often leverage administrative data from a single payer or health system. Results from these analyses may not be generalizable to other populations, given that particular unobserved or unmeasured factors unique to local contexts may bias the estimates (e.g., a health system's leadership or culture may impact the effectiveness of PCMH practice transformation). Second, studies do not use a consistent definition of PCMH. Different approaches to assessing whether primary care practice sites provide care in concordance with PCMH principles would result in different estimates of the effect of PCMH practice transformation on care quality and outcomes, including use of recommended cancer screening services. Particular domains of PCMH-concordant care may have a larger impact on affecting cancer screening rates than other domains. As such, studies using PCMH measures that provide more weight to these particular domains may find larger PCMH practice transformation effects than studies using other PCMH measures.

Measuring PCMH Concordance

In studies, researchers often specify whether a primary care practice delivers PCMH-concordant care based on their certification or accreditation status by a third-party organization. PCMH certification and accreditation, often measured as a binary (achievement of PCMH recognition (0/1) by a third-party organization) or ordinal (level of PCMH recognition under NCQA's three-level system) indicator, may mask differences in underlying performance across the many PCMH domains [16, 17].

In addition, each accreditation organization requires alignment with a different set of standards and may place greater emphasis in their reviews on particular performance measures and domains. The NCQA generally requests additional requirements beyond

those needed by the Joint Commission, including use of an electronic health record system and achievement of minimum clinical performance standards [54, 55]. In addition, the NCQA provides PCMH recognition to specific sites, while the Joint Commission provides PCMH certification to an entire organization, based on 100% of practice sites meeting PCMH principles within three years after certification. As such, measures of PCMH accreditation used in two different studies do not necessarily capture the same set of information.

Moreover, diversity and flexibility in PCMH requirements lead to heterogeneous primary care practice designs that nonetheless result in PCMH recognition. Primary care practices can choose from several different elective criteria to receive PCMH recognition; as such, they may focus attention to particular PCMH domains that differ from other primary care practices [56]. PCMH recognition requirements have also undergone significant changes in the past decade to address concerns raised by health care providers and administrators. For example, the NCQA in 2017 redesigned their PCMH requirements to consolidate an original three-level recognition system into one, and focus standards on clinical outcomes and quality improvement instead of care processes and workflows [57]. Those practices that achieved PCMH recognition before these changes to PCMH requirements may have different practice transformation priorities than those practices that achieved PCMH recognition after these changes were implemented [56, 58].

To address these limitations, some researchers have used validated surveys of providers, practice administrators, and/or patients to measure the extent of practice concordance with PCMH principles [15, 59]. Primary care practice sites may provide

care aligned with PCMH principles, even if they have not formally achieved PCMH recognition by a third-party organization due to limited financial capital or administrative capacity [60]. Provider and patient-level surveys allow for a determination of alignment with individual domains of PCMH-concordant care that is not confounded by facility ability to afford the PCMH recognition process. For example, the Safety Net Medical Home Scale (SNMHS) and Health Center Patient Survey (HCPS) are completed by health center leadership and patients, respectively, and provide an indication of the health center's alignment with certain PCMH domains and attributes.

C. PCMH in FQHCs

In the past decade, FQHCs have demonstrated significant interest in achieving medical home recognition. Indeed, the proportion of FQHCs that have achieved PCMH recognition has increased from 6% in 2010 to 66% in 2015 and 77% in 2018 [6, 39]. A report conducted by Milliman, Inc. on behalf of the NCQA suggests that practices choose to pursue PCMH recognition to drive primary care delivery transformation, improve care quality and patient outcomes, signal high performance to other providers and payers, and improve financial revenues [43]. Health centers also may perceive additional benefits from being aligned with federal agency objectives and initiatives.

Federal health agencies have played a key role in incentivizing FQHCs to adopt the PCMH model. Since 2011, the Health Resources and Services Administration (HRSA), which administers and manages the FQHC program, has provided consulting expertise, technical assistance, and financial support for health centers seeking PCMH accreditation or recognition [61]. HRSA specifically covers all fees associated with initial, renewal, and add-on surveys associated with PCMH recognition. HRSA also

provides annual quality improvement awards to health centers that have achieved PCMH recognition; in 2019, these awards totaled $50 million [62]. In addition, between 2011 and 2014, the Centers for Medicare and Medicaid Services (CMS), under authority established by the Affordable Care Act and the newly created Center for Medicare and Medicaid Innovation (CMMI), conducted a three-year nationwide demonstration (i.e., the FQHC Advanced Primary Care Practice Demonstration) to evaluate the effect of the PCMH delivery model on health care spending and quality of care. As part of the demonstration, CMS provided an additional $6 per member per month care management payment for each Medicare beneficiary who received care at participating health centers. State Medicaid fee-for-service and managed care plans as well as employer-sponsored plans provide additional per member per month care management payments to PCMH-recognized health center sites that provide care for plan beneficiaries [63]. The presence of these financial incentives from public and private payers for medical home primary care delivery has contributed to rapid adoption and accreditation of the PCMH model at FQHCs.

PCMH and Care Quality

While there is substantial attention and interest in PCMH practice transformation among FQHCs, there have been few studies to investigate the impact of PCMH-concordant care delivery on health care quality. Evaluations of PCMH practice transformation efforts at FQHCs have often been limited in scope to select primary care sites of a health center [64, 65]. The few studies leveraging nationally representative data to analyze the effects of PCMH recognition on health care quality at health centers have generally suggested an association between health center PCMH recognition and

improved preventive services utilization and chronic disease management [15-20, 66]. However, these studies relied on cross-sectional data and could not infer any causal associations between PCMH recognition and clinical quality improvement. In addition, these studies measured PCMH concordance using health center PCMH recognition status; as such, the authors were unable to identify whether particular domains of PCMH-concordant care were associated with improved care quality.

Analysis of the FQHC Advanced Primary Care Practice Demonstration found that health centers participating in the Demonstration were more likely to achieve PCMH recognition and were associated with increased FQHC visits and preventive care use among their Medicare beneficiary population [19, 20, 66]. In addition, PCMH-recognized health centers were also associated with increased emergency department use as well as higher Part B and total Medicare expenditures per beneficiary [20]. However, these conclusions are limited in several ways. First, the evaluation was completed within one year of Demonstration conclusion; the impact of PCMH recognition on health center utilization measures may require more time to accrue. PCMH recognition may indicate only the beginning of PCMH practice transformation efforts; moreover, longer alignment with PCMH principles may allow for mastery of PCMH-related processes [17]. In addition, since the FQHC Advanced Primary Care Practice Demonstration evaluation focused on Medicare beneficiaries, the effects of PCMH practice transformation observed cannot be generalized to the overall health center patient population; indeed, subsequent analysis comparing care utilization and quality among Medicaid patients found no differences between those at health center sites participating in the Demonstration and those at comparison sites [19].

Shi et al. conducted a cross-sectional analysis of 2012 clinical performance data of all HRSA-funded health centers and found that PCMH-recognized health centers reported statistically distinguishable improvements in adult weight screening, asthma and diabetes control, tobacco cessation intervention, and prenatal care. These results are consistent with findings from evaluations of local and regional FQHC PCMH practice transformation efforts that suggest an association between PCMH recognition, preventive care utilization, and chronic disease management [64, 65]. Further analysis using similar health center clinical performance data from 2012 to 2015 suggest a lagged effect of PCMH recognition on clinical performance measures; the length of time with PCMH recognition was associated with greater improvements in rates of adult and child weight screening, asthma, aspirin, and lipid therapy, diabetes and hypertension control, and prenatal care [17]. As both studies leverage cross-sectional data analysis techniques, they are limited in their ability to make causal associations between PCMH accreditation and clinical quality measures as well as the potential mechanisms that may facilitate the process improvements resulting from PCMH practice transformation.

D. PCMH and Cancer Screening

Many policymakers and patient advocates have hypothesized that the PCMH model may facilitate improved cancer screening utilization [8, 15]. Existing literature suggests that individuals receiving care at PCMH practices have increased adherence to recommended cancer screening compared to those receiving care at non-PCMH locations [9, 10, 12, 13]. Sinaiko et al. conducted a meta-analysis of 17 studies and concluded that PCMH initiatives were associated with a 1.2 percent increase in cervical cancer screening among all patients and a 1.4 percent increase in breast cancer screening among patients

with two or more major medical co-morbidities [11]. Similarly, an examination of 2218 primary care practices in Michigan found that PCMH status was associated with higher colorectal cancer screening rates among all patients and higher breast and cervical cancer screening rates among patients with low socioeconomic status [14].

The extant literature on the role of PCMH practice transformation among FQHCs suggests mixed effects on cancer screening utilization. The FQHC Advanced Primary Care Practice Demonstration evaluation finds no differences in colorectal screening rates among Medicare beneficiaries at participating Demonstration health centers as compared to those at comparison sites [19]. Similarly, in their analysis of 2012 clinical performance data from all HRSA-funded health centers, Shi et al. report that, after controlling for patient, provider, and health center confounders, PCMH recognition is associated with a 4.1% increase in cervical cancer screening rates and no difference in colorectal cancer screening rates [16]. Longitudinal analysis of 2012 and 2015 clinical performance data suggest statistically significant improvements in colorectal cancer screening rates after one year of PCMH recognition and in cervical cancer screening rates after four years of PCMH recognition [17].

Since health centers do not report breast cancer screening rates in their annual submissions of performance data, few studies have described the effects of PCMH recognition on breast cancer screening utilization at FQHCs. Unadjusted analyses of the CMS demonstration pilot find that, among health centers in the state of California, pilot sites were more likely to achieve PCMH recognition and had higher rates of breast cancer screening for their Medicaid patients as compared to comparison sites [18]. No additional

studies have produced national or other state-level estimates for the impact of FQHC PCMH recognition on breast cancer screening rates.

E. Literature Gap

There are several limitations to the existing literature examining FQHC PCMH adoption and cancer screening utilization. Previous studies relied on health center-level estimates of cancer screening rates, which may be inaccurate due to construct measurement error during review of electronic health records or sampling error during manual patient chart review. Conversations with officials at the American Cancer Society suggest a prevalence of reporting errors in health center-provided data between 2008 and 2014 as FQHC administrators addressed electronic health records implementation challenges as well as changing cancer screening guidelines [67]. Inaccurate electronic health records are particularly an issue with breast and colorectal cancer screening, whose accurate reporting requires communication and coordination with external providers and processes and technology to exchange pertinent health information. Moreover, while the CMS demonstration pilot evaluation did include health center patient surveys, these surveys were limited to Medicare beneficiaries, which comprise only 9% of the health center patients, and do not capture individuals on Medicaid or the uninsured who make up the majority of health center patients [4]. No study to date has utilized nationally representative patient-level data on recommended cancer screening use to examine the role of PCMH practice transformation on cancer screening utilization at FQHCs.

Secondly, the existing literature has used health center-level indicators of PCMH-concordant care and has yet to use nationally representative patient-reported data to identify potential associations between PCMH care concordance and cancer screening

utilization. Most studies measure PCMH-concordance by indicating whether a health center has achieved PCMH recognition or accreditation. However, due to reasons previously described, including multiple third-party recognition organizations and heterogeneity inherent in the recognition process, PCMH recognition alone may not fully capture patient care alignment among the many PCMH care domains. Identification and elaboration of associations between the specific domains of PCMH-concordant care and recommended cancer screening utilization would provide further insight into the relative contribution of each domain in affecting health center cancer screening rates.

Lastly, extant research has not provided any nationally representative estimates on breast cancer screening utilization at FQHCs in particular. Breast cancer screening recommendations generally involve biannual mammograms, which involve access to and coordination with specialist providers outside the health center setting. The frequency and involvement of specialists to provide breast cancer screening may make adherence to breast cancer screening recommendations more challenging than adherence to cervical cancer screening, which can be done at most health centers, and colorectal cancer screening, which involves a specialist but only needs to be done once every ten years. National estimates of breast cancer screening rates at FQHCs would provide perspective on whether or not low-income women who seek care at health centers face challenges with adhering to recommended evidence-based guidelines for breast cancer screening.

I address this literature gap by using recent, national patient-level data to investigate the association between PCMH care concordance and breast, cervical, and colorectal cancer utilization at FQHCs. In addition, I conduct a supplemental analysis

comparing estimates of the association between PCMH care concordance and cancer screening using patient-reported data and health center-reported data.

Chapter 3: Methods

A. Theory and Conceptual Framework

To assess the association between patient-centered medical home (PCMH)-concordant care in federally qualified health centers (FQHCs) and patient use of recommended cancer screening services, I developed a conceptual framework based on the Andersen Behavioral Model of Health Care Use. Andersen's model focuses on the predisposing factors, enabling conditions, and immediate needs which influence use of health care [68]. Predisposing factors are the sociodemographic characteristics and beliefs that influence health services availability and health care utilization. Enabling conditions are the financial and organizational structures and capabilities that facilitate or impede use of health care services. Need characteristics encompass the perceived or evaluated need for health care. The framework recognizes that these predisposing, enabling, and need characteristics occur both on an individual and contextual (organization, community, county, state, etc.) level. In my conceptual model, I outline how PCMH care concordance, a contextual enabling characteristic, is associated with use of cancer screening services (Figure 1). I draw on existing health services literature to identify relevant predisposing, enabling, and need factors to include in the model and to hypothesize potential associations between such factors.

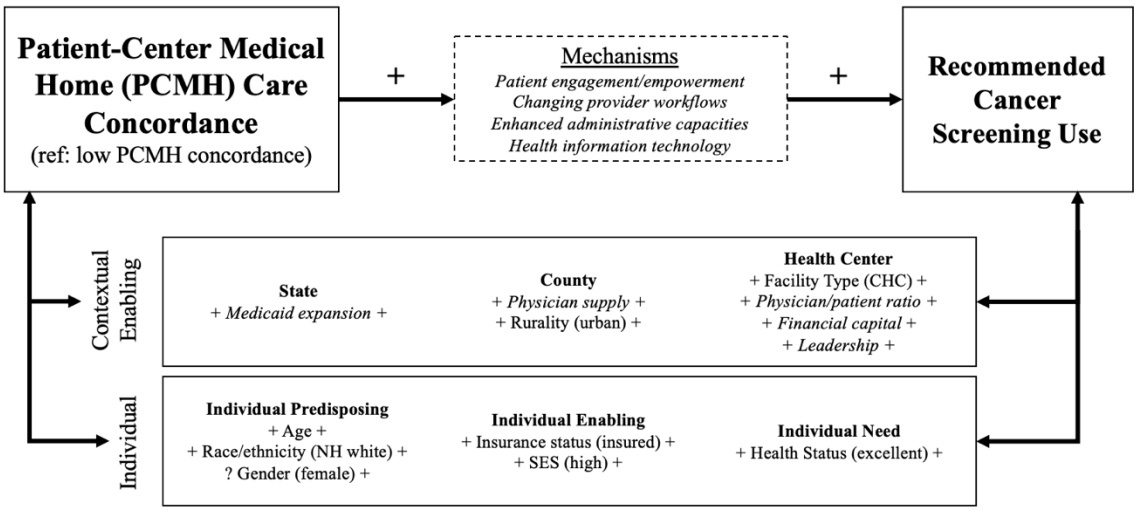
Focal Relationship

The focal relationship of the conceptual model is between PCMH care concordance and recommended cancer screening utilization at FQHCs. *PCMH care concordance* is the alignment of patient care delivery with the defining principles of PCMHs, including (1) care coordination and integration, (2) provision of care

management and support services, (3) emphasis on patient-centered care, (4) enhanced access for patients, and (5) attention to clinical quality improvement [41, 42].

Recommended cancer screening use refers to utilization of breast, cervical, or colorectal cancer screening services as recommended by the US Preventive Services Task Force (USPSTF). The USPSTF strongly recommends screening for breast, cervical, and colorectal cancer for specific high-risk populations [69].

Figure 1: Conceptual Framework



Mediators to the Focal Relationship

Previous literature has detailed four mechanisms describing how PCMH model adoption could improve cancer screening use: (1) increased patient engagement and empowerment; (2) changing provider workflows; (3) enhanced administrative capacities; and (4) use of health information technology [8, 70, 71]. First, the PCMH model requires targeted expansions of appointment availability and attention to patient-provider communication dynamics to improve access to timely and culturally acceptable health care services, including cancer screening. Second, the PCMH model emphasizes changing provider workflows to focus on quality, such as clinical decision support for

adherence to evidence-based cancer screening guidelines and regular quality reporting and registry review among practice providers. Third, adoption of the PCMH model may require practices to hire additional staff to meet the enhanced administrative capacities required to promote quality improvement among clinical providers. These additional staff may improve cancer screening use by conducting outreach to patients overdue for cancer screening and connecting patients with social services to support health care access. Last, PCMH recognition requires investments in health information technology such as electronic health records and patient registries; these technologies can be used to identify and manage patient populations recommended for cancer screening and coordinate their cancer screening with other parts of the health care system. These four dimensions summarize how PCMH care concordance would improve cancer screening rates at FQHCs.

Confounders to the Focal Relationship

Individual Predisposing Characteristics

Demographic confounders include *race/ethnicity*, *age*, and *gender*. The construct of *gender* is only included when investigating the association between PCMH care concordance and colorectal cancer screening. Non-Hispanic white race/ethnicity, older age, and female gender are positively associated with health seeking behaviors and higher uptake of preventive services include recommended cancer screening use [72, 73]. Similarly, older, Non-Hispanic white race/ethnicity patients are more likely to have private insurance or Medicare and receive PCMH-concordant care, as their provider practices may have more resources available to implement and sustain PCMH practice transformation [60, 74]. Thus, the effects of PCMH care concordance on patient health

outcomes differ by race/ethnicity, age, and gender; for example, the PCMH model is associated with larger increases in hypertension control among Hispanic patients than Non-Hispanic White patients. I hypothesize that the effects of PCMH care concordance on cancer screening use is similarly confounded by individual demographic characteristics, as patients of different race/ethnicity, age, and gender may have different experiences with PCMH-concordant care, resulting in diverse effects on improving cancer screening use [74-80].

Individual Enabling Characteristics

Enabling confounders include *insurance status* and *socioeconomic status*. FQHCs with greater proportions of insured patients are more likely to provide PCMH-concordant care and achieve higher cancer screening rates, as insurance improves patient access to care and preventive service use, and insurance reimbursement provides financial capital to invest in structures and processes aligned with PCMH-concordant care delivery [16, 79]. Similarly, *socioeconomic status* (SES) is positively associated with improved adherence to cancer screening guidelines, as increased access to resources would facilitate access to and utilization of health care [81]. While no previous studies have explored SES in the context of FQHCs' PCMH-concordant care delivery, other literature suggests that an individual's socioeconomic status may influence the mechanisms and strategies adopted to provide PCMH-concordant care [80, 82]. Practices located in geographic areas with a greater population of individuals with low SES are more likely to use informal mechanisms (e.g., team-based care and care coordination) than formal mechanisms (e.g., formal care teams and case managers) to provide PCMH-concordant care; these strategies may be differentially effective at promoting cancer screening

utilization [83]. As such, patient socioeconomic status would confound the estimates of the focal relationship by influencing the particular domains of PCMH-concordant care a health center chooses to focus on and thereby affecting patients' ability to access cancer screening.

Individual Need Characteristics

Health status has been independently and differentially associated with cancer screening services. Three common indicators of health status include self-reported perceived health status, number of chronic conditions, and functional limitation due to chronic disease. Individuals with poor self-rated health status are less likely to obtain recommended cancer screening, as poorer self-rated health status may indicate reduced life expectancy and make cancer screening less of a priority for individuals [84]. Individuals with a greater number of chronic conditions or functional limitations are associated with increased cancer screening, potentially due to increased interaction with health care providers, better management of health behaviors, or greater health efficacy [84]. Similar to previously discussed sociodemographic confounders, while no previous studies have investigated the association between patient health status and PCMH care concordance at FQHCs, I hypothesize that provider practices with larger patient populations with poor health status may be less likely to pursue PCMH practice transformation, as these health centers likely have reduced financial capital and administrative capacity available to implement PCMH initiatives.

Health Center Enabling Characteristics

The health center-level constructs of facility type, physician/patient ratio, financial capital, and leadership function as confounders to the focal relationship and are

associated with both a health center's PCMH recognition status (alignment with PCMH principles) and cancer screening rates.

Health center facility type is the primary HRSA funding mechanism through which the health center receives federal grant revenue. The majority of health centers receive general funding to serve low-income and medically underserved communities (as a Community Health Center), while select health centers receive funding to serve particular populations (e.g., migrant workers, those experiencing homelessness, and those living in public housing). Compared with community health centers, the other three types of health centers generally provide health care to patients who are sicker and face greater barriers to care. As such, they are less likely to have available administrative support to achieve PCMH recognition and have lower cancer screening rates.

Health center physician/patient ratio is the ratio of physician full-time equivalents who provide care to patients who seek care at FQHCs. Health centers with a greater physician/patient ratio are more likely to be recognized as a PCMH and are associated with increased cancer screening rates, through increased clinical and administrative capacity to invest in patient care initiatives [16, 85, 86].

Health center financial capital is defined as revenues available for an FQHC to improve clinical quality. These include general funding from federal and state governments and nonprofit foundations, as well as programs funded by public health entities such as the Center for Disease Control and Prevention (CDC) and the American Cancer Society (ACS) that are specific to cancer screening [87]. Health center financial capital can operate as a confounder or a mechanism. Greater health center total revenues and cancer screening-specific grant funding are more likely among PCMH-recognized

FQHCs and are associated with increased cancer screening rates [15, 85, 87, 88]. Practices with greater revenues are more likely to support the upfront investment and ongoing costs of and have the staffing capabilities to support PCMH recognition and practice transformation. In addition, PCMH recognition may function as a mechanism, as PCMH-recognized health centers receive enhanced reimbursement rates, which thus may allow for increased investments in cancer screening services. The existing literature has yet to disentangle whether the confounder or mediator pathway dominates.

Health center leadership captures observed and unobserved characteristics associated with health center leadership that may correlate with decisions to pursue health center PCMH recognition and to increase investments in cancer screening utilization. The construct can potentially operate as a confounder or mechanism. For example, facility leadership may operate as a confounder, as some health center leaders may be more responsive to federal agency interest in PCMH practice transformation and/or efforts to improve cancer screening rates. The PCMH recognition process may also influence health center leaders to pay more attention to clinical quality improvement, including cancer screening utilization; in this sense, facility leadership would operate as a mechanism. Similar to the previous construct of facility financial capital, the existing literature has yet to disentangle whether the confounder or mediator pathway dominates.

Contextual Enabling Characteristics

An important construct at the county-level is *physician supply*, which describes the number of trained physicians working in a county involved in the provision of cancer screening services, including primary care physicians, radiologists, obstetricians and gynecologists, and gastroenterologists. Increased county physician supply is associated

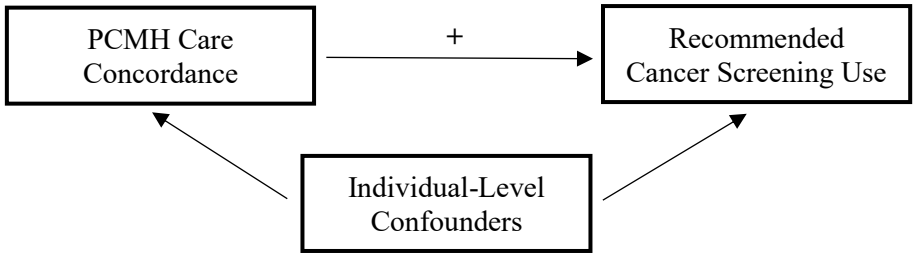
with greater likelihood of FQHC PCMH recognition as well as improved cancer screening rates [89-92]. Patients are more likely to be screened for cancer when there is greater density of providers in the area who can offer such services. Moreover, FQHCs may perceive a greater benefit to adopting the PCMH model when there is a greater potential need for and benefit from care coordination with other providers.

Another county-level construct is *rurality*. Rural primary care practices are less likely than urban practices to provide care in concordance with PCMH principles and have lower cancer screening rates [93, 94]. Rural practices often have decreased financial capital and administrative capacity both to pursue PCMH practice transformation and recognition and to implement programs that improve patient cancer screening use [74].

At the state-level, s*tate Medicaid expansion* status is an indicator for whether a state has expanded its Medicaid eligibility to all individuals with incomes up to 138% of the federal poverty line. Medicaid expansion is associated with greater adoption of the PCMH model as well as increased cancer screening rates [32, 95-97]. Medicaid expansion increases access to health care, including preventive cancer services, to populations newly eligible under expansion guidelines. In addition, FQHCs located in states that have expanded Medicaid are able to receive insurance reimbursement from patients who may otherwise be uninsured. The increased financial capital would allow health centers to invest in PCMH-concordant care structures and processes as well as improved cancer screening services.

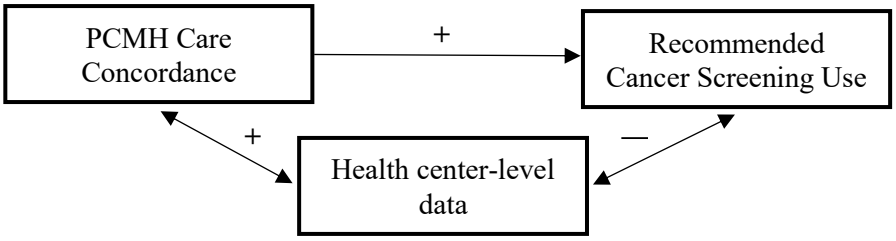
B. Hypotheses

H1. After controlling for confounders, PCMH care concordance is positively associated with cancer screening use at FQHCs.



Given the results of the previous literature review that suggests an association between PCMH practice transformation and improved adherence to cancer screening recommendations, I hypothesize a positive association between PCMH-concordant care and cancer screening use among patients receiving care at FQHCs.

H1a. When comparing estimates using person-level and health center-level data, the association between PCMH care concordance and cancer screening use at FQHCs derived from person-level data is greater than that derived from health center-level data.



As shown in the figure above and for reasons explained below, I hypothesize that health center-level data would generate a negative bias to the focal relationship.

Health center-level data use PCMH recognition status, an incomplete measure of PCMH care concordance likely to overestimate the true degree of PCMH-concordant care provision. First, health centers may report PCMH recognition even when PCMH

recognition has only been achieved for one of multiple sites of health care delivery, overstating a health center's capacity to deliver PCMH-concordant care. Second, health center sites may differ in the extent to which they deliver PCMH-concordant care. PCMH recognition requires achievement of a minimum set of criteria; as such, PCMH recognition does not distinguish those health center sites that reach the minimum threshold for PCMH recognition from other health center sites that meet many more of the criteria. Similarly, some health centers may deliver PCMH-concordant care without achieving PCMH recognition. The inability for health center-level data to capture the degree of PCMH practice transformation would likely result in an underestimate of health centers' provision of PCMH-concordant care. Lastly, health centers' ability to achieve PCMH recognition may be confounded by constructs measured on the individual-level, such as health status. For example, health centers that have patients with better health status are likely to have greater administrative capacity, which is associated with a higher likelihood of PMCH-concordant care delivery and PCMH recognition. Failure to control for these individual-level constructs would overestimate PCMH-concordant care delivery. The balance of the three mechanisms suggests a general overestimate of measurements of PCMH-concordant care delivery when using health center-level data.

In contrast, using health center-level data to measure cancer screening would likely underestimate the true cancer screening rate. Health center-level data on cancer screening rates leverage electronic health records, which may be inaccurate due to errors in physician input (e.g., a physician fails to properly note that a patient has received cancer screening) or computer algorithm (e.g., the EHR system uses an incomplete data source when calculating cancer screening rates). Errors associated with electronic health

records have historically been associated with underestimates of the reported cancer screening rate [98-101]. In addition, health center-level data relies on physicians to follow-up on patient referrals to external providers for cancer screening. The health center may remain unaware of those patients who have received cancer screening from providers outside of the health center if robust protocols to communicate with external providers and follow-up on referrals are not in place. On the other hand, the Hawthorne effect may be present; that is, health centers, recognizing the requirement to report cancer screening rates, may implement practice changes that would increase the likelihood of providers reporting adherence to recommended cancer screening. For example, the EHR could be setup to consistently prompt providers to identify a patient's cancer screening history. In these cases, health center-reported cancer screening rates would be higher than those cancer screening rates if health center-level reporting were not mandated. The balance of these three mechanisms would suggest an overall underestimate of cancer screening measurements when using health center-level data.

To summarize, health center-level data would likely overestimate PCMH-concordant care delivery and underestimate cancer screening rates, resulting in an overall negative bias on the association between PCMH-concordant care delivery and recommended cancer screening use.

C. Dataset

This analysis uses individual-level data on PCMH-concordant care provision as well as cancer screening utilization from the 2014 Health Center Patient Survey (HCPS). The HCPS is a nationally representative, cross-sectional survey of patients who receive care at FQHCs. The survey collects self-reported data on sociodemographic

characteristics, health status, and health care utilization from health center patients. Survey questions are modeled after previously validated questions from other national health surveys. The survey is administered in-person once every five years by the Health Resources and Services Administration (HRSA), with the most recent being fielded between September 2014 and April 2015. Participants must have received care at least once in the prior year at one of four programs funded under Section 330 of the Public Health Service Act: the Community Health Center Program, Migrant Health Center Program, Health Care for the Homeless Program, or the Public Housing Primary Care Program. The survey applies a three-stage sampling design, including stratification, clustering of sample units, and assignment of sampling weights, and oversamples older patients, patients of minority racial groups, and patients in non-Community Health Center settings. The final 2014 HCPS sample included 7,002 individuals at 169 health centers and had a response rate of 91.4% [102].

The Emory University Institutional Review Board did not consider the study as human subjects research, as the study conducts secondary data analyses using publicly available data with no identifiers containing protected health information.

D. Analytic Sample

Three analytic samples are created, one for each type of cancer screening investigated (i.e., breast, cervical, and colorectal cancer). In 2014, the USPSTF recommended for all healthy females between the ages of 50 and 75 screening for breast cancer, and for all healthy females between the ages of 21 and 65 screening for cervical cancer [69]. The USPSTF recommended screening for colorectal cancer for all healthy adults between the ages of 50 and 75 [69]. The final analytic samples thus include all

respondents of the appropriate age and sex who are recommended for cancer screening testing. As the publicly available dataset limits the specificity of the respondents' age, the analytic sample for breast and colorectal cancer screening will only include individuals between the ages of 55 and 74, and the analytic sample for cervical cancer screening will include individuals between the ages of 21 and 64. Observations with unknown or missing values for age, sex, recommended cancer screening use, PCMH care concordance, and any of the confounders are excluded from the analytic sample.

E. Constructs and Measures

A summary of the constructs, associated measures, and their hypothesized relationship with the dependent variable is presented in Table 2.

PCMH Care Concordance

PCMH care concordance is measured among three domains using patient-reported indicators of care coordination and integration; care management and support; and patient-centered care from the 2014 HCPS dataset. Two additional domains, enhanced access and clinical quality improvement, are unmeasured due to dataset limitations.

Following previous literature, the construct of care coordination and integration is measured using two dichotomous indicator variables (Yes or No) that capture whether the health center (1) arranged for services or appointments at other sites and (2) provided counseling related to family or domestic violence, or substance abuse.

Similarly, the construct of care management and support is measured using five dichotomous indicator variables (Yes or No) that capture whether the health center site (1) provided individual or group health education, (2) assisted with application for government benefits, (3) assisted with transportation to medical appointments, (4)

assisted with obtaining free medication, and (5) assisted with basic social needs including housing, employment, childcare, and food [103].

Lastly, the capacity for the health center site to provide patient-centered care is measured as five dichotomous indicator variables for the number of "Always" or "Usually" responses to five survey questions on patient-provider communication [15]. These questions ask whether the respondents feel that the physician or health professional listened carefully, gave easy to understand information, knew important information about their medical history, showed respect, and spent enough time with them.

The overall construct of PCMH-concordant care is measured in two ways: first, as a count variable (0-12) for the total number of measures across the three PCMH domains in which respondents stated they received PCMH-concordant care, and second, as a dichotomous indicator variable for whether the care received was in high or low concordance with the PCMH model, based on whether the patient received PCMH-concordant care on six or more measures. The six-measure threshold separates the respondents into two groups of high and low-PCMH concordance that are similar in proportion to that for health centers' PCMH recognition status.

Cancer Screening Use

The construct of cancer screening utilization is measured as three separate dichotomous indicator variables, one for each analytic sample (breast, cervical, and colorectal screening). Each variable represents whether the respondent has received cancer screening in alignment with the 2014 USPSTF recommendations for cancer screening. Respondents were asked when they last completed the following cancer screening tests: mammogram for breast cancer; both Pap smear and HPV test for cervical

cancer; and colonoscopy, sigmoidoscopy, and stool-based tests for colorectal cancer. These responses are compared to the 2014 USPSTF cancer screening guidelines to determine adherence to recommended cancer screening. In 2014, the USPSTF recommended to all healthy women between the ages of 50 and 75 mammography for breast cancer screening every other year. For cervical cancer screening, all healthy women between the ages of 21 and 65 were recommended Pap testing every three years or Pap and HPV testing every five years. For colorectal cancer screening, all healthy individuals between the ages of 50 and 75 were recommended to complete either a colonoscopy every ten years, sigmoidoscopy every five years, or stool-based testing every year.

Individual Predisposing Confounders

Individual-level predisposing confounders are measured using categorical variables provided in the HCPS. Respondents are categorized into up to seven ordinal age groups (i.e., 21-25, 26-34, 35-44, 45-54, 55-64, 65-74, or 75+) and five racial/ethnic groups (i.e., Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, or Non-Hispanic Other). Respondent gender is measured as a dichotomous variable using self-reported gender (i.e., Male or Female).

Individual Enabling Confounders

The individual-level enabling confounders of insurance status and socioeconomic status are measured using categorical variables. To assess insurance status, respondents were asked whether their current health insurance was provided by their employer, Medicare, Medicaid or the Children's Health Insurance Program (CHIP), their state health insurance exchange, directly from an insurance company, another government

payer, or if they were uninsured. Respondents are categorized into 5 groups based on their self-reported insurance status: Medicaid/CHIP, Medicare, private insurance (which includes insurance provided by an employer, insurance company, or state health exchange), other public insurance, or uninsured.

Socioeconomic status is assessed using five variables: poverty, education, nativity, language, and marital status. Based on previous literature, poverty is measured as an ordinal variable reflecting three poverty levels as reported in the HCPS: ≤ 100% of the federal poverty level, 100-199%, and >200% [104]. Education is measured as an ordinal variable reflecting three levels of educational achievement (i.e., less than high school, high school, or more than high school) based on the respondent's self-reported highest grade or year of school completed. Nativity is measured as a dichotomous indicator variable for whether or not the respondent was born in the United States. Language is measured as a dichotomous indicator variable for whether or not the respondent speaks a language other than English at home. Marital status is measured as a dichotomous variable, and respondents are categorized as either married or living with a partner, or not married, separated, divorced, or widowed.

Individual Need Constructs

The individual-level need confounder of health status is measured as three variables: self-reported health status, number of chronic conditions, and functional health. Based on previous literature, self-reported health status is measured as an ordinal variable as reported in the HCPS: Excellent/Very Good, Good, or Fair/Poor [103, 104]. Number of chronic conditions is measured as a count variable based on the respondent's number of medical comorbidities from the following list: coronary heart disease, angina, heart

attack, stroke, chronic obstructive pulmonary disease, liver conditions, kidney conditions, tuberculosis, high cholesterol, diabetes, asthma, and serious or mild mental illness [103]. Functional health is measured as a dichotomous indicator variable for whether or not the respondent has difficulty with any activity of daily living [103].

Contextual Enabling Constructs

Health center type is measured as a categorical variable reflecting the four funding mechanisms for health centers: Community Health Center, Health Care for the Homeless, Migrant Health Center, and Public Housing Primary Care [105].

The construct of county rurality is measured as a dichotomous indicator variable for whether or not respondents received care in an urban or rural health center, as classified by HRSA [105].

Unmeasured Constructs

Other health center, county, and state-level confounders are unmeasured. Mediators to the focal relationship are also unmeasured.

Table 2. Constructs and their Associated Measures

Construct	**Measures Available**	**Hypothesized Relationship to Dependent Variable**
PCMH-Concordant Care	**PCMH-Concordant Care**. Measured in two ways: • Count variable for the total number of measures across the three PCMH domains (Care Coordination and Integration; Care Management and Support; and Patient-Centered Care) in which the patient responded whether they received PCMH-concordant care • Binary variable for whether the individual received care in high or low concordance with PCMH principles: o High concordance: 6-12 measures o Low concordance 0-5 measures	+
Cancer screening use	**Cancer Screening Use**. Indicator variable for whether the respondent was adherent to recommended cancer screening guidelines, dependent on: • Type of cancer: breast, cervical, or colorectal • Type of screening test • When last completed	NA
Age	**Age**. Respondents are categorized into up to 7 age groups (21-25; 26-34; 35-44; 45-54; 55-64; 65-74; 75+)	+
Race/ethnicity	**Race/Ethnicity**. Respondents are categorized into 5 racial/ethnic groups (Hispanic; Non-Hispanic White; Non-Hispanic Black; Non-Hispanic Asian; Non-Hispanic Other)	[Ref: Non-Hispanic White] -
Gender	**Sex**. Respondents are categorized into 2 groups (Male; Female)	[Ref: Male] +
Insurance status	**Insurance Status**. Respondents are categorized into 5 groups based on their self-reported current insurance status (Medicaid; Medicare, private; other public; or uninsured)	[Ref: Uninsured] +
Socioeconomic status (SES)	**Federal poverty level**. Respondents are categorized into 3 groups based on their income (≤ 100%; 101-199%; ≥ 200% FPL)	[Ref: Low SES] +

	Education. Respondents are categorized into 3 groups based on their highest level of education attained (Less than high school; High school; More than high school) **Nativity**. Indicator variable for whether the respondent was born in the United States **Language**. Indicator variable for whether the respondent speaks a language other than English at home. **Marital Status**. Respondents are categorized into 2 groups (Married / with a partner; Not married / not with a partner (i.e. widowed, divorced, separated, never married))	
Health status	**Self-Reported Health Status**. Respondents are categorized into 3 groups based on their self-reported health status (Excellent/Very Good; Good; Fair/Poor) **Number of Chronic Conditions**. Count variable for the number of medical comorbidities reported. (0 – 12) **Functional Health**. Indicator variable for whether the respondent had difficulty with activities of daily living.	[Ref: Poor Health Status] +/-
Health Center Type	**Health Center Type**. Respondents are categorized into 4 groups based on the type of health center where they received care (Community Health Center; Health Care for the Homeless; Migrant Health Center; Public Housing Primary Care)	+
Health Center physician/patient ratio	*Unmeasured*	+
Health Center financial capital	*Unmeasured.*	+
Health Center leadership	*Unmeasured*	+
County rurality	**Rurality**. Indicator variable for whether the health center was located in an urban or rural setting.	+
County physician supply	*Unmeasured*	+

State Medicaid expansion	*Unmeasured*	+

F. Analytic Strategy

I first conduct descriptive analyses for each analytic sample. Then, I perform two logistic regression analyses for each cancer screening analytic sample to examine the association between provision of PCMH-concordant care and cancer screening use at FQHCs, controlling for confounders. The first regression uses the binary indicator variable to measure high and low PCMH care concordance, while the second regression uses the count variable to measure the degree of PCMH-concordant care delivered. Regression estimates and standard errors are adjusted to account for the complex survey design elements of the data, including stratification, clustering of sample units, and application of sampling weights. Results are reported as average marginal effects estimates corresponding to the full analytic samples.

In addition, I conduct sensitivity analysis to address limitations in measuring age and health insurance status. The HCPS dataset reports age in ten-year increments (e.g., 45-54); the recommended age to start both breast and colorectal cancer screening is 50, which falls in between one of those age bands. While the analytic sample for the main regression model only includes respondents between ages 55 and 74 for breast and colorectal cancer screening, sensitivity analysis expands the analytic sample to include respondents between ages 45 and 54. Additional sensitivity analysis alters the measurement of insurance status to separately categorize respondents who have both Medicaid and Medicare (dual eligible enrollees).

Lastly, to investigate potential differences in estimates when using patient-reported and health center-reported data of PCMH-concordant care provision, recommended cancer screening utilization, and the association between these two

constructs, I conduct a supplemental analysis to compare the estimates calculated using patient-reported data from the 2014 HCPS with estimates calculated using health center-reported data from the 2014 Uniform Data System (UDS). The UDS is a standardized set of measures reported annually by each FQHC to HRSA and includes health center-level information on patient demographics, PCMH accreditation status, and clinical performance, including cervical and colorectal cancer screening utilization. The supplemental analysis uses a multiple linear regression model to examine the association of PCMH recognition on cancer screening use at FQHCs, adjusting for relevant confounders.

For comparable estimates, the analysis of facility-reported data with the UDS dataset uses similar confounders to those included with the analysis of patient-reported data with the HCPS dataset. Table 3 compares those measures used from the health center-level dataset with similar measures used from the patient-reported dataset. Notably, the HCPS dataset includes additional variables on patient socioeconomic status (education, nativity, and marital status) and health status (self-reported health status, chronic disease indicators, and functional health) not found in the UDS dataset. Inclusion of these individual-level measures will allow for determination of their importance in confounding the focal relationship between PCMH-concordant care and cancer screening.

Table 3. Comparison of Person-Level and Health-Center Level Datasets

Construct	HCPS Measures	UDS Measures
PCMH-Concordant Care	**PCMH-Concordant Care**. Measured in two ways: • Count variable for the total number of measures across the three PCMH domains (Care Coordination and Integration; Care Management and Support; and Patient-Centered Care) in which the patient responded they received PCMH-concordant care • Binary variable for whether the individual received care in high or low concordance with PCMH principles: o High concordance: 6-12 measures o Low concordance 0-5 measures	**PCMH Recognition, Certification, or Accreditation.** Indicator variable for whether the health center has received PCMH recognition, certification, or accreditation.
Cancer screening use	**Cancer Screening Use**. Indicator variable for whether the respondent was adherent to recommended cancer screening guidelines, dependent on: • Type of cancer: breast, cervical, or colorectal • Type of screening test When last completed	**Cancer Screening Use**. Percentage of health center patients receiving recommended screening for cervical and colorectal cancer
Age	**Age**. Respondents are categorized into up to 7 age groups (21-25; 26-34; 35-44; 45-54; 55-64; 65-74; 75+)	**Age**. Percentage of health center patients in the following age groups (0-20; 21-24; 25-34; 45-44; 45-54; 55-64; 65-74; 75+)
Race/ethnicity	**Race/Ethnicity**. Respondents are categorized into 5 racial/ethnic groups (Hispanic; Non-Hispanic White; Non-Hispanic Black; Non-Hispanic Asian; Non-Hispanic Other)	**Race/Ethnicity**. Percentage of health center patients in the following race/ethnic groups (Hispanic; Non-Hispanic White; Non-Hispanic Black; Non-Hispanic Asian; Non-Hispanic Other; Unknown)
Gender	**Sex**. Respondents are categorized into 2 groups	**Sex**. Percentage of health center patients who are female.

	(Male; Female)	
Insurance status	**Insurance Status**. Respondents are categorized into 5 groups based on their self-reported current insurance status (Medicaid; Medicare, private; other public; or uninsured)	**Insurance Status**. Percentage of health center patients with the following insurance types (Medicaid; Medicare; private; other public; and uninsured)
Socioeconomic status (SES)	**Federal poverty level**. Respondents are categorized into 3 groups based on their income (≤ 100%; 101-199%; ≥ 200% FPL) **Education**. Respondents are categorized into 3 groups based on their highest level of education attained (Less than high school; High school; More than high school) **Nativity**. Indicator variable for whether the respondent was born in the United States **Language**. Indicator variable for whether the respondent speaks a language other than English at home. **Marital Status**. Respondents are categorized into 2 groups (Married / with a partner; Not married / not with a partner (i.e. widowed, divorced, separated, never married))	**Federal poverty level**. Percentage of health center patients in the following income groups (≤ 100%; 101-199%; ≥ 200%; unknown FPL) **Language**. Percentage of health center patients who are best served in a language other than English.
Health status	**Self-Reported Health Status**. Respondents are categorized into 3 groups based on their self-reported health status (Excellent/Very Good; Good; Fair/Poor) **Number of Chronic Conditions**. Count variable for	**None**.

	the number of medical comorbidities reported. (0 – 12) **Functional Health**. Indicator variable for whether the respondent had difficulty with activities of daily living.	
Health Center Type	**Health Center Type**. Respondents are categorized into 4 groups based on the type of health center they received care (Community Health Center; Health Care for the Homeless; Migrant Health Center; Public Housing Primary Care)	**Health Center Type**. Four indicator variables for each type of funding the health center received (Community Health Center; Health Care for the Homeless; Migrant Health Center; Public Housing Primary Care)
County Rurality	**Rurality**. Indicator variable for whether the health center was located in an urban or rural setting.	**Rurality**. Indicator variable or whether the health center was located in an urban or rural setting.

Chapter 4: Results

A. Descriptive Statistics

Table 4 summarizes the key sociodemographic characteristics for each of the three analytic samples. The breast cancer analytic sample included 608 observations representing a weighted sample of 1,158,604 patients receiving care at federally qualified health centers (FQHCs); the cervical cancer sample included 2,072 observations representing 5,493,642 FQHC patients; and the colorectal cancer sample consisted of 1,080 observations representing 2,453,277 FQHC patients. The estimates were adjusted to account for the complex survey design elements of the data, including stratification, clustering of sample units, and application of sampling weights.

The analytic samples reflected the ages and sex of persons recommended by the US Preventive Services Task Force (USPSTF) for cancer screening. The breast cancer analytic sample consisted of female patients between the ages of 55 and 74; the cervical cancer sample consisted of female patients between the ages of 21 and 64; and the colorectal cancer sample consisted of male and female patients between the ages of 55 and 74.

The sociodemographic distribution across all three analytic samples reflected health centers' objective to provide health care to low-income and medically underserved communities. Most respondents reported income less than or equal to 100% of the Federal Poverty Level (FPL); having public insurance (Medicaid, Medicare, or other) or being uninsured; "Fair" or "Poor" health status; receiving care at a Community Health Center; and living in a rural setting. The majority of patients in each analytic sample

identified as Non-Hispanic White; were born in the United States; and were single, widowed, divorced, or separated.

Table 4. Sociodemographic Characteristics of Federally Qualified Health Center Patients Recommended for Different Cancer Screenings.

	(1) Breast	(2) Cervical	(3) Colorectal	p
Female Sex	1.000	1.000	0.471	**<0.0001**
Age				**<0.0001**
21-25	-	0.133	-	
26-34	-	0.263	-	
35-44	-	0.233	-	
45-54	-	0.222	-	
55-64	0.704	0.148	0.700	
65-74	0.296	-	0.300	
Insurance Status				**<0.0001**
Medicaid	0.353	0.545	0.429	
Medicare	0.316	0.032	0.257	
Private	0.125	0.102	0.116	
Other Public	0.010	0.005	0.005	
Uninsured	0.196	0.316	0.192	
Race/Ethnicity				**0.0153**
Non-Hispanic White	0.669	0.512	0.597	
Non-Hispanic Black	0.158	0.182	0.185	
Non-Hispanic Asian	0.018	0.019	0.011	
Non-Hispanic Other	0.013	0.039	0.024	
Hispanic	0.142	0.248	0.183	
Socioeconomic Status				
Federal Poverty Level (FPL)				**0.0028**
≤ 100% FPL	0.461	0.607	0.535	
101-199% FPL	0.339	0.294	0.265	
≥ 200% FPL	0.200	0.099	0.200	
Education				**0.7531**
Less than high school	0.285	0.331	0.351	
High school	0.314	0.283	0.262	
More than high school	0.401	0.386	0.387	
Nativity (%)	0.876	0.804	0.839	**0.0396**
Second Language at Home (%)	0.134	0.241	0.201	**0.0131**
Marital Status				**0.3079**
Single, widowed, divorced or separated	0.586	0.531	0.584	
Married or have a domestic partner	0.414	0.469	0.416	
Health Status				
Self-Reported Health Status				**0.0273**

Excellent/Very Good	0.167	0.161	0.208	
Good	0.274	0.390	0.298	
Fair/Poor	0.558	0.449	0.494	
Chronic Conditions (#)	1.490	1.117	1.571	**<0.0001**
Functional Difficulties (%)	0.225	0.148	0.175	**0.0721**
Health Center Type				**0.0825**
Community Health Center	0.940	0.917	0.926	
Health Care for the Homeless	0.020	0.035	0.034	
Migrant Health Center	0.029	0.038	0.021	
Public Housing Primary Care	0.011	0.010	0.019	
County Rurality (%)	0.665	0.563	0.579	**0.3419**
Observations	608	2072	1080	

Note: p-values represent results of Pearson's chi square tests of statistical difference among individuals recommended for breast, cervical, and colorectal cancer.

Table 5 presents descriptive statistics on patient-centered medical home (PCMH) care concordance and cancer screening rates among patients receiving care at FQHCs. Overall, for each analytic sample, 62.8% of patients received recommended breast cancer screening, 78.9% received recommended cervical cancer screening, and 62.7% received recommended colorectal cancer screening. The mean number of PCMH attributes reported was 6.3, 6.3, and 6.4 for the breast, cervical, and colorectal cancer analytic samples, respectively. The percentage of patients who received care with high PCMH concordance, defined as concordance with six or more PCMH attributes, was 68.3%, 68.9%, and 73.9% for the breast, cervical, and colorectal cancer analytic samples. Specifically, most patients recommended for breast, cervical, or colorectal cancer screening reported receiving patient-centered care (>88% for all five measures for this domain), and the majority of patients received health center support to arrange for health care at non-health center locations.

Table 5. Receipt of Patient-Centered Medical Home-Concordant Care and Cancer Screening Services among Federally Qualified Health Center Patients Recommended for Cancer Screening.

	(1) Breast	(2) Cervical	(3) Colorectal	p
High PCMH Care Concordance (6+ PCMH attributes)	0.683	0.689	0.738	**0.3096**
Number of PCMH Attributes				
Mean (SD)	6.251 (1.808)	6.312 (1.864)	6.445 (1.713)	**0.1496**
0-5 Attributes	0.317	0.311	0.262	
6-7 Attributes	0.447	0.461	0.494	**0.6678**
8-12 Attributes	0.236	0.227	0.244	
Individual PCMH-Concordant Care				
Patient-Centered Care				
Provider listened carefully to the patient	0.910	0.905	0.941	**0.0747**
Provider explained things in a way that was easy to understand	0.964	0.929	0.966	**0.0499**
Provider knew important information about patient medical history	0.934	0.887	0.947	**0.0343**
Provider showed respect to what the patient had to say	0.916	0.950	0.954	**0.1208**
Provider spent enough time with the patient	0.929	0.922	0.938	**0.6030**
Care Coordination and Integration				
Health center arranged for services/appointment elsewhere	0.578	0.548	0.573	**0.8355**
Health center provided counseling (e.g., substance use, domestic violence)	0.129	0.168	0.114	**0.0638**
Care Management and Support				
Health center provided general health education	0.224	0.277	0.285	**0.2628**
Health center helped patient apply for government benefits	0.188	0.244	0.232	**0.2216**
Health center provided medical transportation	0.086	0.123	0.097	**0.2854**
Health center provided free medication	0.306	0.262	0.321	**0.5324**
Health center helped patient get social services (e.g., get housing, job, and food)	0.088	0.097	0.078	**0.5960**
Obtained recommended screening	0.628	0.789	0.627	**0.0005**
Observations	608	2072	1080	

Note: p-values represent results of Pearson's chi square tests of statistical difference among individuals recommended for breast, cervical, and colorectal cancer.

B. Logistic Regression

Table 6 shows the results, reported as average marginal effects, of the first multivariable logistic regression model, which used a binary indicator variable as the key independent measure for PCMH-concordant care. After controlling for confounders, high PCMH concordance was associated with a 7.6 percentage-point increase ($p = 0.045$) in cervical cancer screening rates among health center patients. In addition, Non-Hispanic Black and Hispanic health center patients were 11.4 ($p = 0.023$) and 20.4 ($p = 0.017$) percentage points more likely to report receiving cervical cancer screening, respectively, than Non-Hispanic White patients. Moreover, health center patients with Medicaid were 17.1 percentage points ($p < 0.001$) more likely to receive cervical cancer screening than patients without health insurance. On the other hand, patients born in the United States (vs. patients born in other countries, $p = 0.023$) were less likely to receive cervical cancer screening.

The model did not find any statistically significant associations between high PCMH concordance and colorectal cancer screening rates. However, minority race/ethnicity and public health insurance status were associated with increased colorectal cancer screening rates. After controlling for confounders, Hispanic patients were 30.1 percentage points ($p = 0.015$) more likely to report receiving colorectal cancer screening than Non-Hispanic White patients. Likewise, patients with Medicaid or Medicare were 19.2 ($p = 0.014$) and 35.4 ($p = 0.003$) percentage points more likely to receive colorectal cancer screening, respectively, than patients without health insurance. Furthermore, patients married or with a domestic partner were 14.9 percentage points ($p = 0.016$) less likely to receive colorectal cancer screening than patients who were single, divorced, widowed, or separated.

The model also did not find any statistically significant associations between high PCMH concordance and breast cancer screening rates. Non-Hispanic Black ($p < 0.001$), Non-Hispanic Other ($p = 0.017$), and Hispanic ($p = 0.048$) patients were more likely to receive breast cancer screening than Non-Hispanic White patients. In addition, patients whose incomes were over 200% FPL were 28.5 percentage points ($p = 0.001$) more likely to receive breast cancer screening than patients who were under 100% FPL. Lastly, patients who needed assistance with at least one activity of daily living were 26.3 percentage points ($p = 0.011$) more likely to receive breast cancer screening than patients who did not face any functional health limitations.

Table 6. Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured as a Binary Indicator (Low/High), on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Cervical	(3) Colorectal
High PCMH Care Concordance (ref: low)	0.023	0.076**	0.008
Female Sex	-	-	0.099
Age			
21-25	-	[Ref]	-
26-34	-	0.043	-
35-44	-	0.061	-
45-54	-	-0.014	-
55-64	[Ref]	-0.151*	[Ref]
65-74	0.093	-	0.059
Insurance Status (ref: uninsured)			
Medicaid	0.097	0.171***	0.192**
Medicare	0.059	0.037	0.354***
Private	0.177	0.039	0.003
Other Public	0.081	-0.141	-0.068
Race/Ethnicity (ref: Non-Hispanic White)			
Non-Hispanic Black	0.413***	0.114**	0.142*
Non-Hispanic Asian	0.122	-0.109	0.127
Non-Hispanic Other	0.280**	0.085	0.173
Hispanic	0.261	0.204**	0.301**
Socioeconomic Status			
Federal Poverty Level (FPL) (ref: ≤ 100% FPL)			
101-199% FPL	0.107	0.040	0.067
≥ 200% FPL	0.285***	0.175	0.005
Education (ref: less than high school)			
High school	0.116	0.059	0.115
More than high school	0.029	-0.050	0.100
Nativity (0/1)	-0.148*	-0.109**	0.036
Second Language at Home (0/1)	-0.069	-0.124	-0.121
Marital Status (married or domestic partner)	0.024	-0.036	-0.149**
Health Status			
Self-Reported Health Status (ref: Excellent/Very Good)			
Good	0.133	0.063	0.108
Fair/Poor	0.038	0.039	0.149
Chronic Conditions (#)	-0.031	-0.022*	-0.004
Functional Difficulties (0/1)	0.336***	-0.007	0.012
Health Center Type (ref: Community Health Center)			
Health Care for the Homeless	0.108	-0.046	0.029
Migrant Health Center	0.170	-0.032	-0.109
Public Housing Primary Care	0.121	-0.002	0.054
County Rurality	-0.091	0.015	0.089
Observations	608	2072	1080

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 7 shows the results, reported as average marginal effects, of the second logistic regression model examining the association between PCMH-concordant care and cancer screening, using a linear count variable of the number of measures reflecting PCMH-concordant care as the key independent measure. The second model suggested that, after controlling for confounders, every additional PCMH attribute was associated with a 3.0 percentage-point ($p = 0.002$) increase in cervical cancer screening. Similar to the first model, Non-Hispanic Black (vs. Non-Hispanic White patients, $p = 0.029$) and Hispanic patients (vs. Non-Hispanic White patients, $p = 0.013$) and patients with Medicaid (vs. uninsured patients, $p < 0.001$) were more likely to receive cervical cancer screening, while patients between ages 55 and 64 (vs. patients between the ages of 21 and 25, $p = 0.046$), patients born in the United States (vs. patients born in other countries, $p = 0.018$), and patients with more chronic conditions (vs. patients with fewer chronic conditions, $p = 0.032$) were less likely to receive cervical cancer screening.

The second model also indicated that every additional PCMH attribute was associated with a 3.3 percentage-point ($p = 0.041$) increase in colorectal cancer screening. Hispanic patients (vs. non-Hispanic White patients, $p = 0.010$) and patients with Medicaid (vs. uninsured patients, $p = 0.024$) or Medicare (vs. uninsured patients, $p = 0.003$) were more likely to receive colorectal cancer screening, and patients who were married or had a domestic partner (vs. patients who were single, widowed, divorced, or separated, $p = 0.014$) were less likely to receive colorectal cancer screening.

Like the first model, which used a binary indicator variable for the key independent measure of PCMH-concordant care, the second model using a linear count variable did not find any statistically significant associations between concordance with

PCMH attributes and breast cancer screening. The second model found that patients identifying as Hispanic (vs. Non-Hispanic White patients, $p = 0.048$), Non-Hispanic Black (vs. Non-Hispanic White patients, $p < 0.001$), or Non-Hispanic Other (vs. Non-Hispanic White patients, $p = 0.016$), patients with incomes greater than 200% FPL (vs. patients with incomes less than or equal to 100% FPL, $p = 0.001$), and patients who require assistance with activities of daily living (vs. patients without any functional health limitations, $p < 0.001$) were more likely to receive breast cancer screening.

Table 7. Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured as a Count of the Number of PCMH Attributes, on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Cervical	(3) Colorectal
Number of PCMH Attributes	0.001	0.030***	0.033**
Female Sex	-	-	0.102*
Age			
21-25	-	[Ref]	-
26-34	-	0.046	-
35-44	-	0.058	-
45-54	-	-0.010	-
55-64	[Ref]	-0.155**	[Ref]
65-74	0.095	-	0.054
Insurance Status (ref: uninsured)			
Medicaid	0.096	0.174***	0.175**
Medicare	0.055	0.056	0.373***
Private	0.183	0.044	0.005
Other Public	0.082	-0.107	-0.061
Race/Ethnicity (ref: Non-Hispanic White)			
Non-Hispanic Black	0.413***	0.109**	0.143*
Non-Hispanic Asian	0.123	-0.128	0.142
Non-Hispanic Other	0.282**	0.075	0.175
Hispanic	0.259**	0.199**	0.330***
Socioeconomic Status			
Federal Poverty Level (FPL) (ref: ≤ 100 % FPL)			
101-199% FPL	0.110	0.046	0.066
≥ 200% FPL	0.290***	0.179*	0.008
Education (ref: less than high school)			
High school	0.112	0.065	0.133*
More than high school	0.025	-0.048	0.100
Nativity (0/1)	-0.144	-0.114**	0.034
Second Language at Home (0/1)	-0.066	-0.125	-0.134
Marital Status (married or domestic partner)	0.023	-0.032	-0.149**
Health Status			
Self-Reported Health Status (ref: Excellent/ Very Good)			
Good	0.132	0.066	0.100
Fair/Poor	0.040	0.037	0.147
Chronic Conditions (#)	-0.031	-0.027**	-0.011
Functional Difficulties	0.340***	-0.010	0.007
Health Center Type (ref: Community Health Center)			
Health Care for the Homeless	0.112	-0.069*	0.002
Migrant Health Center	0.166	-0.031	-0.110
Public Housing Primary Care	0.125	-0.013	0.036
County Rurality (0/1)	-0.092	0.016	0.090
Observations	608	2072	1080

* p < 0.1, ** p < 0.05, *** p < 0.01

C. Sensitivity Analysis

A logistic regression model was conducted examining the association between the 12 individual measures of PCMH-concordant care and cancer screening; results from this logistic regression model can be found in Appendix 1. Additional sensitivity analysis on patient insurance status, which categorizes dual Medicaid and Medicare beneficiaries as a separate category instead of as part of the Medicaid population, did not significantly change model estimates (Appendix 2). Sensitivity analysis expanding the breast and colorectal cancer analytic samples to include individuals ages 45-54 also did not significantly change model estimates (Appendix 3).

Given the inconsistency with the PCMH concordance coefficient estimates between the first and second logistic regression models, which used a binary indicator and linear count variable as the key independent measure for PCMH concordance, an additional, third regression model was estimated to identify whether the inconsistency was due to variation among health centers with high PCMH concordance. As high PCMH concordance is defined by achieving at least half of the 12 PCMH attributes, health centers can reach high PCMH concordance through different PCMH attributes; some health centers may also achieve more PCMH attributes than others. To account for these heterogeneous approaches to achieving high PCMH concordance, the third logistic regression model identified patients receiving care in low (0-5 attributes), high (6-7 attributes), and very high (8-12 attributes) concordance with the PCMH model. Results suggested that the positive association between the PCMH model and cervical cancer screening was only evidenced among those receiving very high PCMH-concordant care;

no association between any level of PCMH-concordant care and breast or colorectal cancer screening at health centers was found (Appendix 4).

Lastly, descriptive statistics and regression model results for an age and sex-restricted analytic sample are presented in Appendix 5-6. Cancer screening recommendations vary by sex and age, and thus variations in the sex and age of each analytic sample prevent direct comparisons of regression estimates across cancer screening outcomes. To allow for comparable estimates between the different types of cancer screening, the analytic samples for all outcomes were restricted to female patients between the ages of 45 and 74. Contrary to findings from the main logistic regression models, the results of the logistic regression model using the age and sex-restricted analytic sample did not identify any association between PCMH-concordant care and use of cancer screening services.

D. Supplemental Analyses

Supplemental analyses compare the descriptive and regression results using patient-level data with those using health center-level data. The supplemental analysis uses the health center as the basic unit of observation, while the previous patient-level analysis uses the individual as the basic unit of observation. Notably, there are three key differences between the health center-level data and patient-level analyses: (1) the health center-level data measures of race/ethnicity and poverty include an unknown category; (2) the health center-level data does not include measures of individual health status; and (3) the health center-level data does not include measures of individual marital status or nativity, key components of the socioeconomic status construct. Table 8 details the

descriptive statistics of the analytic samples using health center-level data, and Table 9 shows the results of the logistic regression analyses using health center-level data.

Using health center-reported data, an estimated 68.8 percent of health centers achieved PCMH recognition for at least one practice site in 2014 (Table 8). Health center cancer screening programs were effective for 51.2 percent of health center patients recommended for cervical cancer screening and 31.6 percent of health center patients recommended for colorectal cancer screening.

PCMH recognition among health centers was associated with an increase in cervical and colorectal cancer screening program effectiveness (Table 9). Cervical and colorectal cancer screening programs at health centers with at least one site recognized as a PCMH were 6.8 ($p < 0.001$) and 4.0 ($p < 0.001$) percentage points, respectively, more effective than programs at health centers without PCMH recognition. Health centers with higher proportions of female patients, patients with Medicaid or private health insurance, and patients above the poverty level were also more likely to have achieved higher cancer screening rates.

Table 8. Descriptive Statistics of Federally Qualified Health Center Patients Using Health Center-Reported Data.

	(1)
Cervical cancer screening	0.512
Colorectal cancer screening	0.316
PCMH recognition or accreditation	0.688
National Committee for Quality Assurance (NCQA)	0.527
The Joint Commission (TJC)	0.117
Sex	
Female	0.569
Age	
00-20	0.305
21-24	0.055
25-34	0.145
35-44	0.133
45-54	0.148
55-64	0.127
65-74	0.056
75+	0.030
Insurance Status	
Medicaid	0.407
Medicare	0.097
Private	0.178
Other Public	0.011
Uninsured	0.307
Race/Ethnicity	
Non-Hispanic White	0.428
Non-Hispanic Black	0.193
Non-Hispanic Asian	0.041
Non-Hispanic Other	0.032
Hispanic	0.255
Unknown Race	0.052
Federal Poverty Level (FPL)	
≤ 100% FPL	0.487
101-199% FPL	0.158
≥ 200% FPL	0.057
Unknown FPL	0.298
Language	0.183
Health Center Type	
Community Health Center	0.928
Health Care for the Homeless	0.209
Migrant Health Center	0.133
Public Housing Primary Care	0.067
Health Center Rurality	0.545
Observations	1278

Table 9. Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured by Health Center Medical Home Recognition or Accreditation, on Cervical and Colorectal Cancer Screening Use, Using Health Center-Level Data.

	(1) Cervical	(2) Colorectal
PCMH recognition or accreditation	0.068***	0.040***
Sex		
Female	0.434***	0.198**
Age		
00-20	-0.291	-0.514
21-24	0.260	0.447
25-34	-0.007	-0.583
35-44	-1.368***	-1.269**
45-54	0.171	0.086
55-64	-0.548	-0.458
65-74	-0.648	-0.204
75+	[Ref]	[Ref]
Insurance Status		
Medicaid	0.099***	0.165***
Medicare	0.109	0.280*
Private	0.174***	0.254***
Other Public	0.430***	0.213
Uninsured	[Ref]	[Ref]
Race/Ethnicity		
Non-Hispanic White	[Ref]	[Ref]
Non-Hispanic Black	0.383	-0.015
Non-Hispanic Asian	-0.073	-0.105**
Non-Hispanic Other	-0.106**	0.047
Hispanic	0.046	0.029
Unknown Race	-0.119*	0.013
Federal Poverty Level (FPL)		
≤ 100% FPL	[Ref]	[Ref]
101-199% FPL	0.142***	0.140***
≥ 200% FPL	0.068	0.161**
Unknown FPL	-0.047*	-0.033
Language	0.217***	0.171***
Health Center Type		
Community Health Center	0.008	0.026
Health Care for the Homeless	-0.012	-0.020
Migrant Health Center	-0.006	-0.006
Public Housing Primary Care	-0.026	0.040**
Health Center Rurality	-0.027**	-0.042***
Observations	1278	1278

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Chapter 5: Discussion

A. Summary of Results

This study used patient, self-reported data to analyze the impact of patient-centered medical home (PCMH) care concordance on cancer screening use at federally qualified health centers (FQHCs). I found mixed results for the association between PCMH-concordant care and cancer screening. My results offered suggestive evidence of an association between PCMH concordance and cervical cancer screening, mixed evidence regarding a possible association between PCMH concordance and colorectal cancer screening, and no evidence of an association between PCMH concordance and breast cancer screening. These results partially align with the published consensus on the association between PCMH care concordance and cancer screening, and provide mixed evidence for the hypothesis that there is a positive relationship between delivery of PCMH-concordant care and cancer screening use.

B. Implications

In 2014 Health Center Patient Survey (HCPS) data, among health center patients who are recommended each type of cancer screening, 62.8% received breast cancer screening, 78.9% received cervical cancer screening, and 62.7% received colorectal cancer screening. In comparison, national estimates of recommended cancer screening utilization in 2013 were 78.4% for breast cancer screening, 83.4% for cervical cancer screening, and 65.5% for colorectal cancer screening [106]. The HCPS estimates are generally lower than national estimates for cancer screening use; such a finding is to be expected given that health center patients face financial and cultural barriers to accessing care and are at higher risk for not receiving preventive services [107]. In addition, the

greater disparity in breast cancer screening rates between health center patients and the general population may be due to the frequency of and barriers to access breast cancer screening. Breast cancer screening involves a biannual mammogram, often requiring referral to an external specialist. As such, health center patients, who are disproportionately from low socioeconomic backgrounds and uninsured or on Medicaid, are likely to face barriers with (1) finding providers willing to offer breast cancer screening for free or at a low-cost, (2) identifying providers who are geographically accessible and available at times convenient for the patient, and (3) scheduling and attending these screening visits every other year [108, 109].

The HCPS also provided estimates of whether patients perceive that the health center delivers care in concordance with the PCMH model. While most patients reported receiving patient-centered care from health centers, they also reported low levels of care coordination and integration as well as care management and support. These findings are similar to previous estimates of PCMH-concordant care among health center patients with hypertension [103]. The low levels of care coordination and management services may reflect the need for increased financial, administrative, and technology resources to consistently provide these PCMH-concordant care attributes to all health center patients [110].

My findings partially align with the developing consensus that PCMH-concordant care improves cancer screening use among health center patients. Previous literature using health center-level measures have found positive associations between PCMH concordance and cancer screening at health centers [16, 17, 19]. This study is the first to use patient-level measures of PCMH care concordance and cancer screening. My study

provided strong evidence of a positive association between PCMH care concordance and cervical cancer screening and estimated that PCMH care concordance is associated with a 3.0 to 7.6 percentage-point increase in cervical cancer screening. These coefficient estimates are similar in direction and magnitude to those from previous studies using health center-level data [16-18]. In addition, my study provided mixed evidence of an association between PCMH care concordance and colorectal cancer screening. Evidence from previous cross-sectional studies using health center-level data have also been mixed, a finding that may be explained by the fact that the improved care quality associated with PCMH care concordance may take time to develop [16, 18]. Indeed, longitudinal studies using health center-level data observe greater increases in colorectal cancer screening use among health centers that have achieved PCMH recognition for longer periods of time [17]. Lastly, my study is the first to provide national estimates for breast cancer screening and its association with PCMH care concordance among health center patients. I do not find any evidence of such an association between PCMH care concordance and breast cancer screening.

The observed association between PCMH concordance and improved cervical cancer screening use may be a result of processes related to PCMH practice transformation and accreditation. Previous studies have documented that hiring additional quality improvement specialists and enhancing data collection and measurement systems were important components to PCMH practice transformation [111]. Indeed, conversations with health center administrators at YourTown Health, a network of six health centers in Northwest Georgia, indicated that PCMH practice transformation required changes in provider workflow and health information technology to improve

patient data collection, facilitate care coordination with external providers, and reinforce focus on clinical quality improvement [112, 113]. Future research should seek to identify whether there exists a causal relationship, and if so, the specific mechanisms by which the PCMH model improves cancer screening use. Similarly, this study did not identify associations between particular domains of the PCMH model (e.g., care coordination and integration; care management and support; or patient-centered care) and cancer screening use; however, previous studies have noted that effective patient-provider communication, coordinated care, and supportive and enabling services facilitated increased use of health care services [36, 110]. Future research should seek to identify the relative impact of concordance with individual PCMH domains on cancer screening use.

Particular domains of PCMH care concordance may differentially impact the use of cancer screening services among breast, cervical and colorectal cancer, as the pathways to receiving cancer screening differ for each cancer type. Health centers often do not have the capacity to conduct breast and colorectal cancer screening; rather, they refer patients to external providers. In contrast, most health centers provide cervical cancer screening either during an annual physical or as opportunistic screening when patients visit the health center to receive care for an illness. Therefore, PCMH attributes to improve care coordination and integration with external providers—through improved data collection systems and standardized provider workflows to track patient referrals—may be particularly impactful to improve breast and colorectal cancer screening use. Similarly, as breast and colorectal cancer screening require additional health care visits, care management and support services that decrease barriers to accessing care, including connecting patients with social services, may facilitate successful patient follow-up on

these referrals. These two domains of the PCMH model, care coordination and integration as well as care management and support, may be less relevant for improving cervical cancer screening use among health center patients, as cervical cancer screening does not require patients to schedule a separate appointment or find an external provider.

This study also found that certain patient sociodemographic characteristics are associated with cancer screening use. Patients with Medicaid or Medicare were more likely than patients without insurance to receive cervical and colorectal cancer screening. It is well documented how health insurance coverage increases access to and utilization of care, including cancer preventive services; as such, health centers should consider connecting patients with insurance enrollment specialists and social services agencies to ensure that eligible patients are enrolled in public insurance programs to facilitate patient adherence to recommended cancer screening [79]. Similarly, patients from minority race/ethnicity groups were more likely to receive cervical and colorectal cancer screening. Programs targeted for health center patients such as the CDC-supported National Breast and Cervical Cancer Early Detection Program and similar initiatives from the American Cancer Society and other public health organizations may explain the improved cancer screening uptake and reduced screening disparities among these populations [114]. Continued attention to cancer screening disparities is crucial as health centers serve underserved populations who often experience health inequities.

The supplemental analysis compared the cancer screening estimates between patient-level data reported from the 2014 HCPS and health center-level data reported from the 2014 Uniform Data System (UDS). The HCPS estimated screening rates for cervical and colorectal cancer of 78.9% and 62.7%, respectively. In contrast, health

center-reported data suggested lower cervical and colorectal cancer screening rates of 51.2% and 31.6%, respectively. The extant literature has documented the relative strengths and limitations of each approach; patient-reported cancer screening data may produce overestimates due to patient recall bias and measurement error, while health center-reported cancer screening data most likely underestimate screening rates due to errors related to the use of electronic health record algorithms to identify receipt of cancer screening services [36]. As such, the true cancer screening rate among health center patients likely lies somewhere between the estimates produced using patient-level and health center-level data.

The regression models of the association between PCMH concordance and cancer screening using patient-level and health center-level data suggest a likely positive association between PCMH concordance and cervical cancer screening. Notably, the supplemental analysis finds estimates of the association between PCMH concordance and cancer screening to be greater when using health center-level data than patient-level data; these results are not aligned with my hypothesis. Models using health center-level data also suggested an association between PCMH concordance and colorectal cancer screening, which was not found in some of the models using patient-level data. The inconsistent estimates suggest the importance of including detailed patient socioeconomic status and health status measures as potential confounders that would bias health center-level estimates of the association between PCMH concordance and cancer screening. Regression models using patient-level data, for example, indicate that patient marital status affects colorectal cancer screening use, with individuals who are married or have a domestic partner being less likely to receive colorectal cancer screening. As such, failure

to account for this key confounder would bias the regression coefficient estimates away from the null. The models using patient-level data also indicated that other measures of patient health status, including functional health decline and chronic conditions, were positively associated with breast or cervical cancer screening; their exclusion would also exert bias on model estimates.

C. Strengths and Limitations

This study has several key limitations that should be discussed. First, this study is cross-sectional and therefore cannot establish causality. Second, omitted variable bias is a potentially important concern, since key endogenous constructs, such as facility physician/patient ratio, financial capital, and leadership, are unmeasured. Some of these unmeasured constructs may also be affected by potential reverse causality. For example, health centers that achieve PCMH accreditation may have greater financial capital, given enhanced reimbursement from payers. These additional funds may be used to increase receipt of recommended cancer screening services among health center patients. On the other hand, health centers with greater financial capital—and thus more administrative capacity—may be more likely to pursue PCMH practice transformation, which could increase screening use through other mechanisms. Additional detailed survey data would be needed to inform the exact role of these unmeasured constructs on the focal relationship between PCMH-concordant care provision and cancer screening use. Third, the study was only able to measure three of the five domains of PCMH care concordance. As such, the study's results are unable to describe the role and importance of the remaining two domains—enhanced access and continuous quality improvement—on cancer screening use. Lastly, this study relies on patient self-reported data on cancer

screening use and frequency, which can be inaccurate due to recall bias and other measurement error. However, the survey items employed by this study are similar to those validated and used in other national surveys and have been widely used by researchers to assess public health trends.

In spite of these limitations, the study has some key strengths. First, the study uses a nationally representative dataset capturing individual health care attitudes and utilization of a traditionally hard-to-reach population. The use of individual-level data addresses potential inaccuracies with health center-reported data related with electronic health record design, implementation, and measurement of cancer screening rates. Second, the individual-level data allow for identification of PCMH-concordant care, reducing biases associated with health center-level measures of PCMH concordance. Health center-level measures of PCMH concordance rely on PCMH recognition or accreditation indicators, which overestimate the degree of PCMH concordance among health centers that have not yet achieved recognition at all their sites and underestimate the degree of PCMH concordance among health centers that may have aligned themselves with the PCMH model but have not invested in the accreditation process. Lastly, this study is the first to provide national estimates of breast cancer screening use and the association between the PCMH model and breast cancer screening in FQHCs.

This study uses the most recently available data from the 2014 HCPS. HRSA plans to administer an updated HCPS in the next few years [115]. Descriptive and longitudinal analyses on PCMH concordance and cancer screening using the updated dataset would provide more recent, patient self-reported estimates of cancer screening use and its association with PCMH-concordant care provision, and would further inform

federal government and health center efforts to implement the PCMH model and promote cancer screening.

D. Policy Implications

The findings of the study underscore the potential for the PCMH model to improve cancer screening use at FQHCs. These results add to a growing body of literature suggesting increases in preventive services use and cancer screening associated with the PCMH model. Importantly, these findings demonstrate the potential effectiveness of the PCMH model among primary care practices that primarily serve low-income and medically underserved patient populations who have historically experienced disparities in access to care and use of preventive services.

Federal policymakers in the Department of Health and Human Services (HHS) and the Health Resources and Services Administration (HRSA) have sought to improve the quality of care delivered at health centers. Since 2016, over $100 million has been awarded each year to support health centers' efforts to improve clinical performance measures, including through adoption of the PCMH model [116]. The potential for PCMH practice transformation to improve cancer screening use and reduce disparities in screening uptake and may motivate further investment in PCMH adoption among health centers and primary care practices primarily serving low-income patients.

Similarly, health centers may perceive the PCMH model as an effective investment when seeking to improve their clinical performance. Health centers often face significant financial pressure from payers through value-based payment initiatives to demonstrate excellent care quality and patient outcomes. These initiatives tie provider reimbursement or bonus payments to certain quality metrics, including cancer screening

rates. The findings of this study may help to guide budget allocation decisions by health center leaders when deciding how to improve such quality metrics. PCMH may be a particularly attractive choice, given its potential to both improve care quality and qualify health centers for enhanced reimbursement from payers.

Chapter 6: Conclusion

While previous research has investigated the association between patient-centered medical home (PCMH)-concordant care and cancer screening at federally qualified health centers (FQHCs), those studies have relied almost exclusively on health center-level data, which may produce inaccurate estimates of both PCMH concordance and cancer screening as well as the relationship between them. This study uses recent, national, patient-level data to investigate the association between PCMH care concordance and cancer screening. I find that health center patients who receive PCMH-concordant care are more likely to receive recommended cervical cancer screening. In addition, I find mixed results for associations between PCMH concordance and colorectal cancer screening and do not find any significant associations between PCMH concordance and breast cancer screening. These results present mixed evidence for the PCMH model as a means to improve cancer screening. These findings suggest the need for further research into how PCMH practice transformation may facilitate improved cancer screening rates, and importantly, how the various domains of PCMH care concordance may differentially affect breast, cervical, and colorectal cancer screening use in primary care practices whose patients are primarily from low-income, medically underserved populations.

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Appendices

Appendix 1. Average Marginal Effects of Patient-Centered Medical Home (PCMH) Concordance, Measured by Individual PCMH Domains, on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Cervical	(3) Colorectal
Patient-Centered Care			
Provider listened carefully to the patient	0.243*	0.200***	0.095
Provider explained things in a way that was easy to understand	0.033	-0.204***	0.142
Provider knew important information about patient medical history	-0.233*	0.049	-0.110
Provider showed respect to what the patient had to say	-0.034	0.098*	-0.227
Provider spent enough time with the patient	-0.228	0.046	0.181
Care Coordination and Integration			
Health center arranged for services/appointment elsewhere	0.043	0.012	0.009
Health center provided counseling (e.g., substance use, domestic violence)	0.030	0.053	0.254**
Care Management and Support			
Health center provided general health education	-0.019	0.020	0.046
Health center helped patient apply for government benefits	0.051	0.018	-0.110
Health center provided medical transportation	0.080	-0.017	-0.050
Health center provided free medication	-0.059	-0.049	0.037
Health center helped patient get social services (e.g., get housing, job, and food)	0.080	0.097*	0.167**
Sex			
Female	-	-	0.067
Age			
21-25	-	[Ref]	-
26-34	-	0.026	-
35-44	-	0.031	-
45-54	-	-0.044	-
55-64	[Ref]	-0.177***	[Ref]
65-74	0.032	-	0.063
Insurance Status			
Medicaid	0.055	0.166***	0.170**
Medicare	0.054	0.089	0.337***
Private	0.118	0.043	0.038
Other Public	0.038	-0.123	-0.096
Uninsured	[Ref]	[Ref]	[Ref]
Race/Ethnicity			
Non-Hispanic White	[Ref]	[Ref]	[Ref]
Non-Hispanic Black	0.406***	0.112**	0.182**
Non-Hispanic Asian	0.096	-0.112	0.201
Non-Hispanic Other	0.268**	0.050	0.153
Hispanic	0.263*	0.191***	0.362***

Socioeconomic Status			
Federal Poverty Level (FPL)			
≤ 100% FPL	[Ref]	[Ref]	[Ref]
101-199% FPL	0.073	0.041	0.066
≥ 200% FPL	0.263***	0.132	-0.011
Education			
Less than high school	[Ref]	[Ref]	[Ref]
High school	0.144*	0.057	0.123*
More than high school	0.058	-0.035	0.082
Nativity (%)	-0.146	-0.104**	0.039
Second Language at Home (%)	-0.109	-0.112	-0.168*
Marital Status (Married or have a domestic partner)	0.058	-0.029	-0.147**
Health Status			
Self-Reported Health Status			
Excellent/Very Good	[Ref]	[Ref]	[Ref]
Good	0.170*	0.024	0.084
Fair/Poor	0.084	0.020	0.143
Chronic Conditions (#)	-0.036**	-0.020*	-0.021
Functional Difficulties (%)	0.269***	-0.011	0.018
Health Center Type			
Community Health Center	[Ref]	[Ref]	[Ref]
Health Care for the Homeless	0.016	-0.055	-0.041
Migrant Health Center	0.150	-0.050	-0.107
Public Housing Primary Care	0.132	-0.025	0.062
County Rurality (%)	-0.073	0.030	0.069
Observations	608	2072	1080

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix 2. Sensitivity Analysis of Insurance Status Measure (Separately Categorize Individuals with both Medicare and Medicaid) – Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured as a Binary Indicator, on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Cervical	(3) Colorectal
High PCMH Care Concordance (ref: low)	0.023	0.075**	0.016
Female Sex	-	-	0.101
Age			
21-25	-	[Ref]	-
26-34	-	0.043	-
35-44	-	0.061	-
45-54	-	-0.011	-
55-64	[Ref]	-0.137	[Ref]
65-74	0.097	-	-0.012
Insurance Status (ref: uninsured)			
Medicaid/Medicare	0.078	0.084	0.308***
Medicaid	0.111	0.185***	0.136
Medicare	0.054	0.031	0.397***
Private	0.175	0.038	0.005
Other Public	0.079	-0.144	-0.071
Race/Ethnicity (ref: Non-Hispanic White)			
Non-Hispanic Black	0.415***	0.116**	0.139
Non-Hispanic Asian	0.120	-0.127	0.103
Non-Hispanic Other	0.282**	0.095	0.162
Hispanic	0.259**	0.197**	0.286**
Socioeconomic Status			
Federal Poverty Level (FPL) (ref: ≤ 100% FPL)			
101-199% FPL	0.109	0.044	0.052
≥ 200% FPL	0.287***	0.177	-0.001
Education (ref: less than high school)			
High school	0.112	0.055	0.117
More than high school	0.025	-0.051	0.112
Nativity (%)	-0.141	-0.111**	0.014
Second Language at Home (%)	-0.067	-0.114	-0.112
Marital Status (married or domestic partner)	0.022	-0.038	-0.140**
Health Status			
Self-Reported Health Status (ref: Excellent/Very Good)			
Good	0.133	0.063	0.085
Fair/Poor	0.039	0.040	0.134
Chronic Conditions (#)	-0.031	-0.022*	-0.006
Functional Difficulties (%)	0.337***	-0.004	-0.005
Health Center Type (ref: Community Health Center)			
Health Care for the Homeless	0.107	-0.046	0.027
Migrant Health Center	0.171	-0.036	-0.114
Public Housing Primary Care	0.124	0.000	0.048
County Rurality (%)	-0.086	0.018	0.064
Observations	608	2072	1080

* p < 0.1, ** p < 0.05, *** p < 0.01

Appendix 3. Sensitivity Analysis of Age (Include Individuals Ages 45-54 for Breast and Colorectal Cancer Screening) – Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured as a Binary Indicator, on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Colorectal
High PCMH Care Concordance (ref: low)	0.050	0.007
Female Sex	-	0.036
Age		
45-54	[Ref]	[Ref]
55-64	-0.017	0.237***
65-74	0.065	0.307***
Insurance Status (ref: uninsured)		
Medicaid	0.224***	0.154**
Medicare	0.202**	0.344***
Private	0.178**	0.056
Other Public	0.148	0.090
Race/Ethnicity (ref: Non-Hispanic White)		
Non-Hispanic Black	0.141*	0.026
Non-Hispanic Asian	0.121	0.201
Non-Hispanic Other	0.395**	0.312**
Hispanic	0.235*	0.079
Socioeconomic Status		
Federal Poverty Level (FPL) (ref: ≤ 100% FPL)		
101-199% FPL	0.051	0.039
≥ 200% FPL	0.169	-0.021
Education (ref: less than high school)		
High school	0.062	0.041
More than high school	0.091	0.004
Nativity (%)	-0.122	-0.068
Second Language at Home (%)	-0.027	-0.072
Marital Status (married or domestic partner)	-0.128	-0.173***
Health Status		
Self-Reported Health Status (ref: Excellent/Very Good)		
Good	0.024	-0.011
Fair/Poor	0.091	0.038
Chronic Conditions (#)	-0.011	0.015
Functional Difficulties (%)	0.134*	0.054
Health Center Type (ref: Community Health Center)		
Health Care for the Homeless	-0.180**	-0.060
Migrant Health Center	0.093	-0.115
Public Housing Primary Care	0.011	-0.008
County Rurality (%)	-0.041	0.059
Observations	608	1080

* p < 0.1, ** p < 0.05, *** p < 0.01

Appendix 4. Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured in Tertiles, on Cancer Screening Use, by Cancer Screening Type.

	(1) Breast	(2) Cervical	(3) Colorectal
PCMH Care Concordance			
Low (0-5 attributes)	[Ref]	[Ref]	[Ref]
High (6-7 attributes)	0.048	0.065	-0.042
Very High (8-12 attributes)	-0.030	0.099*	0.120
Female Sex	-	-	0.083
Age			
21-25	-	[Ref]	-
26-34	-	0.045	-
35-44	-	0.059	-
45-54	-	-0.015	-
55-64	[Ref]	-0.153*	[Ref]
65-74	0.081	-	0.074
Insurance Status (ref: uninsured)			
Medicaid	0.101	0.172***	0.185**
Medicare	0.058	0.041	0.361***
Private	0.164	0.041	0.034
Other Public	0.046	-0.135	-0.023
Race/Ethnicity (ref: Non-Hispanic White)			
Non-Hispanic Black	0.419***	0.113**	0.127
Non-Hispanic Asian	0.126	-0.114	0.131
Non-Hispanic Other	0.275**	0.076	0.143
Hispanic	0.247*	0.202**	0.304**
Socioeconomic Status			
Federal Poverty Level (FPL) (ref: ≤ 100% FPL)			
101-199% FPL	0.104	0.042	0.076
≥ 200% FPL	0.281***	0.179	0.015
Education (less than high school)			
High school	0.093	0.060	0.136*
More than high school	0.031	-0.052	0.109
Nativity (%)	-0.137	-0.112**	0.036
Second Language at Home (%)	-0.065	-0.126	-0.119
Marital Status (married or domestic partner)	0.017	-0.033	-0.168***
Health Status			
Self-Reported Health Status (ref: Excellent/Very Good)			
Good	0.120	0.064	0.105
Fair/Poor	0.035	0.040	0.165*
Chronic Conditions (#)	-0.028	-0.024*	-0.017
Functional Difficulties (%)	0.322***	-0.006	0.007
Health Center Type (ref: Community Health Center)			
Health Care for the Homeless	0.127	-0.055	0.001
Migrant Health Center	0.190	-0.032	-0.116
Public Housing Primary Care	0.107	-0.005	0.023
County Rurality (%)	-0.075	0.013	0.087
Observations	608	2072	1080

* p < 0.1, ** p < 0.05, *** p < 0.01

Appendix 5. Sociodemographic Characteristics of Federally Qualified Health Center Patients Recommended for Different Cancer Screenings, Female Cohort Only.

	(1) Breast	(2) Cervical	(3) Colorectal
PCMH Care Concordance	0.683	0.700	0.682
Obtained recommended screening	0.628	0.666	0.701
Age			
45-54	0.000	0.599	0.000
55-64	0.704	0.401	0.705
65-74	0.296	0.000	0.295
Insurance Status			
Medicaid	0.353	0.394	0.352
Medicare	0.316	0.072	0.317
Private	0.125	0.132	0.125
Other Public	0.010	0.008	0.010
Uninsured	0.196	0.395	0.196
Race/Ethnicity			
Non-Hispanic White	0.669	0.580	0.670
Non-Hispanic Black	0.158	0.198	0.157
Non-Hispanic Asian	0.018	0.013	0.018
Non-Hispanic Other	0.013	0.037	0.013
Hispanic	0.142	0.172	0.143
Socioeconomic Status			
Federal Poverty Level (FPL)			
≤ 100% FPL	0.461	0.592	0.461
101-199% FPL	0.339	0.321	0.340
≥ 200% FPL	0.200	0.086	0.199
Education			
Less than high school	0.285	0.332	0.285
High school	0.314	0.319	0.314
More than high school	0.401	0.349	0.400
Nativity (%)	0.876	0.847	0.875
Second Language at Home (%)	0.134	0.183	0.134
Marital Status			
Single, widowed, divorced or separated	0.586	0.535	0.585
Married or have a domestic partner	0.414	0.465	0.415
Health Status			
Self-Reported Health Status			
Excellent/Very Good	0.167	0.159	0.168
Good	0.274	0.300	0.273
Fair/Poor	0.558	0.541	0.559
Chronic Conditions (#)	1.490	1.360	1.491
Functional Difficulties (%)	0.225	0.227	0.226
Health Center Type			
Community Health Center	0.940	0.923	0.939
Health Care for the Homeless	0.020	0.033	0.020
Migrant Health Center	0.029	0.033	0.029
Public Housing Primary Care	0.011	0.011	0.011
County Rurality (%)	0.665	0.624	0.666
Observations	608	1050	608

Appendix 6. Average Marginal Effects of Patient-Centered Medical Home Concordance, Measured as a Binary Indicator, on Cancer Screening Use, by Cancer Screening Type, Female Cohort Only.

	(1) Breast	(2) Cervical	(3) Colorectal
High PCMH Care Concordance (ref: low)	0.023	0.055	-0.021
Age			
45-54	-	[Ref]	-
55-64	[Ref]	-0.205***	[Ref]
65-74	0.093	-	-0.045
75+	-	-	-
Insurance Status			
Medicaid	0.097	0.214***	0.009
Medicare	0.059	0.065	0.234*
Private	0.177	0.093	0.033
Other Public	0.081	-0.155	-0.174
Uninsured	[Ref]	[Ref]	[Ref]
Race/Ethnicity			
Non-Hispanic White	[Ref]	[Ref]	[Ref]
Non-Hispanic Black	0.413***	0.199***	0.069
Non-Hispanic Asian	0.122	0.120	0.234
Non-Hispanic Other	0.280**	0.288***	0.115
Hispanic	0.261**	0.223*	0.244*
Socioeconomic Status			
Federal Poverty Level (FPL)			
≤ 100% FPL	[Ref]	[Ref]	[Ref]
101-199% FPL	0.107	0.037	0.058
≥ 200% FPL	0.285***	0.222	0.067
Education			
Less than high school	[Ref]	[Ref]	[Ref]
High school	0.116	0.134	0.014
More than high school	0.029	0.066	0.022
Nativity (%)	-0.148*	-0.094	0.072
Second Language at Home (%)	-0.069	-0.080	-0.103
Marital Status (Married or have a domestic partner)	0.024	-0.159**	-0.231***
Health Status			
Self-Reported Health Status			
Excellent/Very Good	[Ref]	[Ref]	[Ref]
Good	0.133	0.206*	0.025
Fair/Poor	0.038	0.129	0.088
Chronic Conditions (#)	-0.031	-0.039*	-0.005
Functional Difficulties (%)	0.336***	0.015	-0.000
Health Center Type			
Community Health Center	[Ref]	[Ref]	[Ref]
Health Care for the Homeless	0.108	-0.116*	0.020
Migrant Health Center	0.170	0.071	-0.183
Public Housing Primary Care	0.121	0.113	-0.113
County Rurality (%)	-0.091	0.007	0.074
Observations	608	1050	608

* p < 0.1, ** p < 0.05, *** p < 0.01