Patient-Centered Medical Home and its Associations with Healthcare Utilization and Expenditures

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Abstract of Dissertation

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Objectives: Continually increasing U.S. healthcare costs have heavily burdened society. To mitigate this situation, the patient-centered medical home (PCMH) has been highly promoted, but existing findings on PCMH were inconsistent. This study, therefore, examined the certified PCMH (versus non-PCMH) and its associations with healthcare utilization and expenditures.

Data Source and Study Setting: This study used the Medical Expenditure Panel Survey and Medical Organizations Survey data. The population with multiple chronic conditions (MCC) was selected because chronic conditions have continually been a concern due to their heavy influence on rapidly increased healthcare utilization and expenditures. As the theoretical framework, the Andersen model was used to apply three factors: predisposing, enabling, and healthcare needs.

Study Design: This study applied a retrospective observational cross-sectional analysis. Since some healthcare utilization and expenditure dependent variables have large proportions of zeros, a two-part analysis was employed using the hurdle model and two-part model.

Principal Findings: The results showed some significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine purchases (3.60 times less) for the population with MCC; no significant associations existed for prescribed medicine expenditures from total payment sources and the out-of-pocket payment source. Other results showed no statistically significant differences.

Conclusions: This research confirmed findings from existing literature that the PCMH model has decreased associations with prescribed medicine purchases. Additional policy efforts should be made regarding PCMHs, especially with the purchase and management of prescribed medications. Providing more benefits while controlling expenditures is especially important when considering future policy drives to support the implementation and expansion of PCMHs.

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Chapter 1: Background

In the United States, rapid increases in healthcare costs have continually been a significant concern (Xin et al., 2014). In 2021, the U.S. national health expenditure was $12,914 per capita, and total national health expenditures were $4.3 trillion, comprising 18.3% of the 2021 U.S. gross domestic product (GDP; Centers for Medicare and Medicaid Services [CMS], 2023). Despite this significant healthcare spending, the suboptimal quality of care and poor health outcomes found in the U.S. healthcare system indicate serious inefficiencies (Xie et al., 2021).

The rising prevalence of chronic conditions is one cause behind excessive healthcare costs (Almalki, Karami, et al., 2018). Almost half of all U.S. adults have at least one chronic condition, and about a quarter of them are estimated to have two or more (Almalki, Karami, et al., 2018). With such high prevalence rates, the treatment of chronic conditions and the complications that lead to avoidable hospitalizations and non-urgent emergency room (ER) visits tied to unmanaged chronic conditions are estimated to eventually account for 86% of all U.S. healthcare costs (Almalki, Karami, et al., 2018). Costs at that level compromise the entire federal budget and eventually create a huge economic burden for society (Almalki, Karami, et al., 2018; An & Lau, 2018).

To mitigate the rising costs and improve efficiency, efforts have focused on the role of primary care in the U.S. healthcare system (Almalki, Karami, et al., 2018). Among efforts to improve primary care, the patient-centered medical home (PCMH) has attracted significant attention as an advanced primary care model that can improve primary healthcare delivery; in fact, most states have PCMH initiatives in place (Bowdoin et al., 2018; Reibling, 2016; Xie et al., 2021). The PCMH concept was initially proposed by the

American Academy of Pediatrics (AAP) in 1967 to target children with special healthcare needs; later, in 2004, AAP redefined the PCMH model, enlarging its scope to include all children (Han et al., 2017). Today, the model has been expanded to include all populations.

According to the AAP, the PCMH is a coordinated, comprehensive, continuous, accessible, compassionate, family-centered, and culturally appropriate healthcare delivery model (Romaire et al., 2012a). The PCMH model is ideally guided by a personal healthcare provider supported by a team who has collective responsibility for the patient; coordinated across the entire healthcare system; and integrated into the patient's community (Romaire et al., 2012a). Compared to non-PCMH patients, those treated under the PCMH model are expected to have fewer unmet healthcare needs, more suitable healthcare service use, better health outcomes, enhanced healthcare satisfaction, and reduced healthcare expenditures (Romaire et al., 2012a). PCMH is an innovative approach to healthcare delivery that holds the conceptual promise of lowering healthcare costs while enhancing healthcare quality (Xin et al., 2014).

Patient-centered care puts the patient first and arranges healthcare services for the patient rather than demanding the patient adjust to the healthcare setting (Mitchell et al., 2020). Compared to typical care, patient-centered care applies more comprehensive healthcare principles that incorporate the specific faiths, values, and demands of individual patients and their families to provide culturally competent and sensitive care (Mitchell et al., 2020). Patient-centered care incorporates four major concepts—the holistic, the individual, the respectful, and the empowering—by concentrating on patients beyond their healthcare conditions (Mitchell et al., 2020). After initially arising to fulfill

the demands of patient-centeredness within a setting of continuous healthcare, the PCMH gained momentum as a promising primary healthcare delivery model that rectifies the uncoordinated, fragmented, reactive, and provider-centered U.S. healthcare system (Mitchell et al., 2020; Romaire et al., 2012b).

Healthcare providers who take a patient-centered approach with the triple aim of enhancing health outcomes, increasing healthcare quality, and controlling expenditures can best promote and implement the PCMH model (An & Lau, 2018). As an enhanced primary care practice model, PCMH acts as a central hub of all healthcare practices, resources, and settings for patients' healthcare (Han et al., 2017). Across the United States, significant efforts have been made in advocating the implementation of PCMH, and the 2010 Patient Protection and Affordable Care Act (ACA) provided the needed financial support (Han et al., 2017).

While some variations exist in the definition and operationalization, the PCMH model requires healthcare delivery to follow a set of joint principles, including a personal primary care physician (PCP) who guides healthcare practices; broad-spectrum team-based support; whole-person orientation; integrated and coordinated healthcare; improved safety, quality, and access to healthcare; and reduced costs (An & Lau, 2018; Xin et al., 2014). Patients frequently demand coordinated healthcare and helping them secure specialty care referrals and track follow-ups might improve the chance patients receive the needed healthcare services (Yonek et al., 2018). In the PCMH model, coordinated healthcare throughout the system and the community results in increased access to healthcare that incorporates various aspects of care (Mitchell et al., 2020). Improved accessibility, such as expanded office hours and open scheduling, can also lead to fewer

delayed and missed healthcare checkups (Yonek et al., 2018). PCMH also increases access to healthcare by enabling patients to receive multiple outpatient treatments in one location, which lowers the transportation obstacles patients have when accessing multiple locations (Mitchell et al., 2020). Meanwhile, the comprehensiveness of PCMH can improve the early identification of disease and promote getting the appropriate treatment (Yonek et al., 2018). PCMH provides healthcare services in a team-based manner, where the patient's personal physician guides a team of other healthcare providers who collectively target the specific aims for the patient (Mitchell et al., 2020).

Research and existing implementations of the PCMH model suggest it can enhance chronic condition management. Care for chronic conditions requires comprehensive efforts that demand coordinated management in exercise, food consumption, and monitoring (Almalki, Alotaibi, et al., 2018). To accomplish such efforts, leading primary healthcare organizations have suggested elevating the primary healthcare delivery approach to the PCMH model instead of the usual primary care (Almalki, Alotaibi, et al., 2018). PCMH is a primary healthcare model that aims to enhance patient health outcomes by providing the resources needed to successfully manage chronic conditions (Almalki, Alotaibi, et al., 2018). By taking a patient-centered approach, PCMH alters how primary healthcare services are designed and delivered to patients (Almalki, Karami, et al., 2018). In recent years, PCMH has been widely adopted by U.S. healthcare stakeholders for an increasing number of adults with chronic conditions to prevent and impede the progression of specific chronic conditions (Almalki, Karami, et al., 2018).

For instance, the Health Resources and Services Administration (HRSA) has contracted with the National Committee for Quality Assurance (NCQA), The Joint Commission (TJC), and the Accreditation Association for Ambulatory Health Care (AAAHC) to support health centers in acquiring and maintaining their PCMH accreditation status (HRSA, 2023). These three organizations help health centers by providing technical support and instructions as a part of the PCMH accreditation process (HRSA, 2023). However, these PCMH accreditors vary in their content, particular criteria, assessment procedures, and necessary documentation (Mahmud et al., 2018).

To start, NCQA engages in site-level PCMH accreditation, which means that even sites affiliated with the same healthcare practice are required to seek PCMH accreditation separately (Mahmud et al., 2018). Healthcare practices can gain a Level 1, 2, or 3 NCQA PCMH accreditation, depending on how many specific standards a practice met for PCMH (Mahmud et al., 2018). NCQA stresses competencies in information technology (IT), an area comprising almost half of the NCQA's PCMH accreditation scores (Mahmud et al., 2018).

In contrast, TJC engages in organization-level PCMH accreditation, which means all sites affiliated with the same healthcare practice can obtain a single common PCMH accreditation (Mahmud et al., 2018). TJC's PCMH accreditation requires healthcare practices to satisfy the TJC ambulatory care accreditation criteria, which require sites to achieve foundational medical home elements that do not disproportionally stress IT competencies (Mahmud et al., 2018). Notably, TJC demands that sites gather patient experience data, something NCQA does not demand (Mahmud et al., 2018).

Similarly, AAAHC engages in organization-level PCMH accreditation, which makes healthcare practices seek medical home accreditation and obtain foundational ambulatory care accreditation (Mahmud et al., 2018). AAAHC's PCMH accreditation criteria require healthcare practices to devise policies associated with staff advancement, patient care, and preventative efforts (Mahmud et al., 2018). Nearly one-fourth of AAAHC's PCMH accreditation scores come from the advancement of these policies; however, due to a lack of specific instructions, how these policies are interpreted and implemented can vary from site to site (Mahmud et al., 2018).

Over the past 20 years, many studies have reported that the PCMH model can lower avoidable healthcare utilization and expenditures in diverse populations and settings (Almalki, Alotaibi, et al., 2018). For instance, some research has shown that PCMH implementation lowered healthcare payments generally and emergency department expenditures specifically (Almalki, Alotaibi, et al., 2018). Other research has demonstrated that PCMH implementation lowered healthcare utilization, especially for emergency department visits, specialist healthcare visits, hospitalizations, and inpatient admissions (Almalki, Alotaibi, et al., 2018).

Despite these findings, state and federal policymakers have not seen enough rigorous evidence on whether PCMH implementation supports efficient healthcare and financial savings at the population level, particularly for chronic conditions (Almalki, Alotaibi, et al., 2018). Information on whether PCMH implementation provides any financial savings especially remains insufficient and ambiguous, even if the notion is theoretically supported (Xin et al., 2014). The U.S. Agency for Healthcare Research and Quality (AHRQ) performed a systematic review of 11 studies in 2012 that produced an

overall low strength of evidence regarding whether PCMH could reduce healthcare utilization (Xin et al., 2014). The review discovered that PCMH reduced emergency department visits in the older adult population but failed to show the same for inpatient admissions (Xin et al., 2014). The evidence also did not show that PCMH lowers total healthcare expenditures in the adult population or all economic outcomes in the child population, including inpatient admissions, ER visits, and total expenditures (Xin et al., 2014).

These mixed results could stem from the broad definition of PCMH, resulting in what is measured as PCMH being quite variable (Reibling, 2016). For example, according to the NCQA (2023), the PCMH theme consists of six concepts: (a) team-based practice arrangement and care delivery, (b) comprehension and management of patients, (c) patient-centered care access and continuity of care, (d) management of care and support, (e) coordination and transition of care, and (f) measurement of performance and quality improvement efforts. Accreditation criteria are then categorized under each concept; these criteria include specific tasks in which a healthcare practice must demonstrate sufficient accomplishment to gain NCQA PCMH certification (NCQA, 2023). The criteria are developed from the best-performing healthcare practices and evidence-based instructions, and a healthcare practice must pass all 40 core criteria and at least 25 credits of elective criteria across the concept areas to receive NCQA PCMH certification (NCQA, 2023). Even if healthcare practices pass all core criteria and gain NCQA PCMH accreditation, variations still exist in the elective criteria among practices, which can result in heterogeneity in PCMH care. Moreover, most studies used some PCMH characteristics to construct a unique model to research since accreditation

information is rarely gathered. PCMH characteristics can be combined in many ways, so constructing a PCMH only causes more heterogeneity in measuring the effect of the model, which can lead to inconsistent results.

In addition, wider PCMH adoption has been hindered by the specificity of existing studies, which makes findings difficult to generalize (Xie et al., 2021). Prior studies have analyzed the PCMH model using only one kind of certification, targeting one specific geographic area, or examining one specific healthcare setting (e.g., the Veterans Health Administration), all of which lowers the generalizability of the findings (Xie et al., 2021). Most research on PCMH implementation has also been limited to specific clinical settings, specific populations (e.g., low-income populations or populations with specific health conditions), or specific healthcare cost outcomes (e.g., inpatient costs or out-of-pocket costs; Romaire et al., 2012b). Moreover, many studies were conducted in specific regional healthcare systems or were specific pilot demonstration programs; therefore, findings cannot be easily generalized (Xin et al., 2014). Similar problems exist with PCMH implementation studies that employed intervention groups with small sample sizes or a small number of healthcare practices, which limits the generalizability of findings (Xin et al., 2014). Consequently, more research is needed on PCMH (versus non-PCMH) and its associations with healthcare utilization and expenditures using an accurate operationalization of PCMH. More generalizable research is also needed to supplement the specificity of current studies, thereby helping to expand PCMH adoption.

Since the PCMH model is expanding and gaining more public attention, a thorough evaluation of the model is needed to clearly understand how much a national

investment in PCMH impacts public health (Xie et al., 2021). As outlined above, existing evidence on PCMH remains inconsistent due to the heterogeneity in defining and operationalizing PCMH and the specificity of prior studies, making it difficult to draw definitive conclusions and generalize findings (Xie et al., 2021). This study, therefore, examined the PCMH model and its associations with healthcare utilization and expenditures using data from the Medical Expenditure Panel Survey (MEPS) and the Medical Organizations Survey (MOS) to address the identified research gap. Unlike many studies, this study used publicly accessible observational data to assess PCMH and its associations with healthcare utilization and expenditures among the population with multiple chronic conditions (MCC). Since MEPS is a nationally representative dataset, the results can have external validity, which can be valuable to policymaking and obtaining the federal budget. Targeting MCC is also appropriate considering the rapid rise in the prevalence of chronic conditions, which leads to increased expenditures for chronic condition treatment and complications (Almalki, Karami, et al., 2018).

1.1. The study aims and contributions

Existing research has not yet analyzed how having a certified PCMH (versus a non-PCMH) associates with healthcare utilization and expenditures for a population with MCC on a nationally representative scale. This research seeks to address that gap by using MEPS and MOS data to examine the associations between having a certified PCMH (versus a non-PCMH) and the healthcare utilization and expenditures for the population with MCC. By using nationally representative MEPS and MOS data, this study can help broaden the scope and produce generalizable results. This study also

analyzed healthcare utilization and expenditures by examining specific types of healthcare services used, which allows for analyzing how distinct types of healthcare service utilization and expenditures are associated with certified PCMH. Since healthcare utilization and expenditures for managing chronic conditions are rising rapidly and burdening the healthcare system, targeting the population with MCC is appropriate because managing MCC is even more difficult and costly than managing a single chronic condition. Moreover, this study used PCMH accreditation (any kind and any level) as a PCMH variable to mitigate the above-mentioned heterogeneity in PCMH's definition and operationalization. Healthcare practices with PCMH accreditation can be treated as PCMH more reliably than constructed PCMHs, which are developed using some PCMH characteristics. This analysis would help verify how certified PCMH associates specific types of healthcare utilization and expenditures for the population with MCC, which could generate generalizable findings that could later influence public policy. Even though knowing how PCMH and healthcare quality are associated is important to understand the overall influence of PCMH, this study does not focus on this topic since doing so is infeasible given the time constraint of this research.

1.2. Research questions

A. Dependent variable: Healthcare utilization

1. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the total number of healthcare outpatient visits—including office-based provider visits and hospital outpatient department provider visits—for a population with MCC?

2. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the number of hospital ER visits for a population with MCC?

3. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the total number of hospital discharges, including zero-night stays, for a population with MCC?

4. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the length of hospital inpatient stays for a population with MCC?

5. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the total number of prescribed medicine purchases—including the initial purchase and refills—for a population with MCC?

B. Dependent variable: Healthcare expenditures

a. Total payment sources

1. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the total expenditures from the total payment sources for a population with MCC?

2. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the total payment sources for a population with MCC?

3. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the total payment sources for a population with MCC?

4. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the total payment sources for a population with MCC?

5. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the total payment sources for a population with MCC?

b. Out-of-pocket payment source

1. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and the total expenditures from the out-of-pocket payment source for a population with MCC?

2. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the out-of-pocket payment source for a population with MCC?

3. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the out-of-pocket payment source for a population with MCC?

4. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the out-of-pocket payment source for a population with MCC?

5. Are there any significant associations between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the out-of-pocket payment source for a population with MCC?

1.3. Study hypotheses

A. Dependent variable: Healthcare utilization

1. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total number of healthcare outpatient visits—including office-based provider visits and hospital outpatient department provider visits—for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and an increased total number of healthcare outpatient visits—including office-based provider visits and hospital outpatient department provider visits—for a population with MCC.

2. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total number of hospital ER visits for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and a decreased total number of hospital ER visits for a population with MCC.

3. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total number of hospital discharges, including zero-night stays, for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and a decreased total number of hospital discharges, including zero-night stays, for a population with MCC.

4. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the length of hospital inpatient stays for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and a decreased length of hospital inpatient stays for a population with MCC.

5. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total number of prescribed medicine purchases—including the initial purchase and refills—for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and a decreased total number of prescribed medicine purchases—including the initial purchase and refills—for a population with MCC.

B. Dependent variable: Healthcare expenditures

a. Total payment sources

1. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total expenditures from the total payment sources for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased total expenditures from the total payment sources for a population with MCC.

2. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the total payment sources for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and increased outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the total payment sources for a population with MCC.

3. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the total payment sources for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased hospital ER expenditures from the total payment sources for a population with MCC.

4. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the total payment sources for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased hospital inpatient expenditures from the total payment sources for a population with MCC.

5. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the total payment sources for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine expenditures from the total payment sources for a population with MCC.

b. Out-of-pocket payment source

1. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and the total expenditures from the out-of-pocket payment source for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased total expenditures from the out-of-pocket payment source for a population with MCC.

2. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the out-of-pocket payment source for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and increased outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the out-of-pocket payment source for a population with MCC.

3. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the out-of-pocket payment source for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased hospital ER expenditures from the out-of-pocket payment source for a population with MCC.

4. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the out-of-pocket payment source for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased hospital inpatient expenditures from the out-of-pocket payment source for a population with MCC.

5. H_0: No significant associations exist between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the out-of-pocket payment source for a population with MCC.

H_1: Some significant associations exist between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine expenditures from the out-of-pocket payment source for a population with MCC.

1.4. Study objectives

A. Dependent variable: Healthcare utilization

1. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total number of healthcare outpatient visits—including office-based provider visits and hospital outpatient department provider visits—for a population with MCC.

2. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total number of hospital ER visits for a population with MCC.

3. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total number of hospital discharges, including zero-night stays, for a population with MCC.

4. Examine the associations between having a certified PCMH (versus a non-PCMH) and the length of hospital inpatient stays for a population with MCC.

5. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total number of prescribed medicine purchases—including the initial purchase and refills—for a population with MCC.

B. Dependent variable: Healthcare expenditures

a. Total payment sources

1. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total expenditures from the total payment sources for a population with MCC.

2. Examine the associations between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the total payment sources for a population with MCC.

3. Examine the associations between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the total payment sources for a population with MCC.

4. Examine the associations between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the total payment sources for a population with MCC.

5. Examine the associations between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the total payment sources for a population with MCC.

b. Out-of-pocket payment source

1. Examine the associations between having a certified PCMH (versus a non-PCMH) and the total expenditures from the out-of-pocket payment source for a population with MCC.

2. Examine the associations between having a certified PCMH (versus a non-PCMH) and outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the out-of-pocket payment source for a population with MCC.

3. Examine the associations between having a certified PCMH (versus a non-PCMH) and hospital ER expenditures from the out-of-pocket payment source for a population with MCC.

4. Examine the associations between having a certified PCMH (versus a non-PCMH) and hospital inpatient expenditures from the out-of-pocket payment source for a population with MCC.

5. Examine the associations between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures from the out-of-pocket payment source for a population with MCC.

1.5. Conceptual framework

The conceptual framework for this study is based on Andersen's (1995) behavioral model of health service use. The model establishes predisposing characteristics, enabling resources, and needs as the proximate determinants of health service utilization, all of which may be influenced by the general external environment and the healthcare system (Reibling, 2016). As measures of health status and symptoms, needs factors are generally considered the direct cause for patients seeking services (Reibling, 2016). Predisposing characteristics include individual-level predictors of service use, such as gender, age, race, or socioeconomic status (Reibling, 2016). Finally, enabling characteristics consist of variables that facilitate the use of services; typically used measures include health insurance, geographic location, or the presence of a usual source of care (USC; Reibling, 2016). Figure 1 depicts the conceptual framework based on Andersen's behavioral model of health service use.

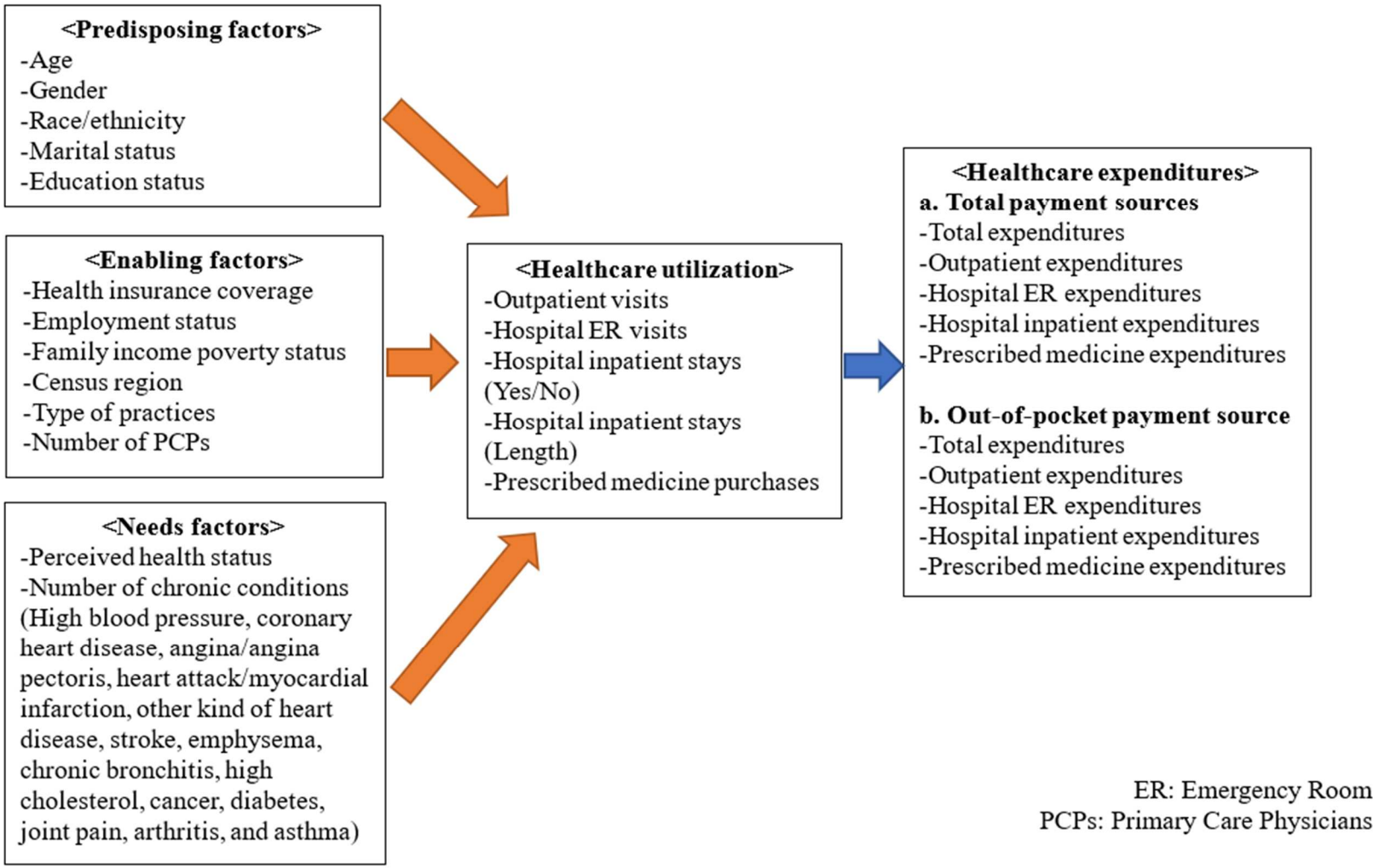

Figure 1. Conceptual framework using Andersen model.

Chapter 2: Literature Review

1. Introduction

The U.S. healthcare system is highly fragmented (Helfgott, 2012). For almost 20 years, the system has consistently failed to provide patients with high-value healthcare services; instead, the healthcare provided is burdensome on patients and high-priced, despite the suboptimal health outcomes (Arend et al., 2012; Helfgott, 2012). Healthcare providers and patients are discontented, and the excessive healthcare costs tied to the system have culminated in a critical point that could be called an epidemic state (Helfgott, 2012).

As the CMS statistics highlighted in the Background section show, U.S. healthcare expenditures are enormous. More concerning, in comparison to other industrialized countries, the U.S. spends considerably more money on healthcare but consistently lags in major health outcomes (Arend et al., 2012). The United States spent 18.8% of its GDP on healthcare in 2020, which is about 9.12% higher than the average of the 38 Economic Cooperation and Development (OECD) countries (Arend et al., 2012; OECD, 2023). In addition, the U.S. per capita annual healthcare spending in 2020 was $11,859.2—about 2.77 times higher than the average of the 38 OECD countries (Arend et al., 2012; OECD, 2023). Yet U.S. health outcomes and healthcare quality are less than optimal despite the United States paying significantly more for healthcare than other OECD countries (Arend et al., 2012). Within that context, serious concerns have been raised regarding healthcare coordination, safety, quality, and costs—leaving health policy experts seeking to identify a more efficient healthcare delivery method to improve the U.S. healthcare system (Helfgott, 2012).

To mitigate this situation, the U.S. must fundamentally transform its healthcare delivery method; the best way to achieve this transformation has been the focus of heated discussions (Arend et al., 2012). The PCMH model has been offered as a highly promising approach to enhance healthcare quality, improve patient and provider experiences, and lower healthcare costs (Arend et al., 2012). PCMH reorders the healthcare system to better align healthcare processes with patient demands, integrating the long-established merits of primary healthcare with recent innovations in healthcare practices (Arend et al., 2012).

PCMH also offers a way to provide comprehensive primary healthcare services that include optimal care access, timeliness, healthcare coordination, patient-centeredness, treatment planning, patient and provider engagement, and population health (Linman et al., 2019). For instance, PCMH provides same-day appointments and after-hours/weekend appointments to improve patient access to primary healthcare services (Linman et al., 2019). PCMH adopts registries, the use of healthcare coordinators, and electronic support tools as well to ensure all patients can access the appropriate services, including proper screenings and preventative care (Linman et al., 2019). In addition, PCMH takes a team-based healthcare delivery approach to increase and maximize the time healthcare providers spend with patients (Linman et al., 2019). According to the American College of Physicians, PCMH coordinates patient treatment through PCPs to ensure that the needed healthcare is provided at the appropriate time, location, and manner (Budgen & Cantiello, 2017).

Many PCMH and PCMH-like initiatives have already been implemented across the United States—not only in healthcare plans, Medicare demonstration projects, and

Medicaid programs, but also across various payer combinations (Cole et al., 2019). As of 2018, multi-payer PCMH initiatives were operating in 18 U.S. states, while the remaining states are actively preparing for similar initiatives (Cole et al., 2019).

The PCMH model enjoys institutional support, including from medical professional societies and the U.S. federal government (Linman et al., 2019). Notably, the government has promoted PCMH by providing alternative payment model provisions through the Medicare Access and CHIP Reauthorization Act (MACRA) and the ACA (Linman et al., 2019). MACRA was enacted to provide incentives to PCMH-accredited healthcare practices by automatically crediting their healthcare quality and performance measurements; the adoption of PCMH is expected to further increase (Hong et al., 2018). Therefore, a better understanding of the healthcare practice characteristics related to PCMH accreditation is a crucial aspect in the improvement of the healthcare system.

Meanwhile, the U.S. healthcare system has faced considerable threats from the high-priced and complicated management of chronic conditions, heavily burdening the U.S. healthcare system (Farley et al., 2019). Most chronic condition management occurs in primary healthcare settings, which potentially offers better prevention and treatment outcomes (Farley et al., 2019). In the current environment, the rapidly aging population means the prevalence of chronic conditions is steadily increasing, which in turn increases healthcare expenditures. This situation emphasizes the need to examine the effectiveness of the PCMH model.

However, existing research has shown inconsistencies regarding PCMH and its associations with healthcare utilization and expenditures. These inconsistencies stem from the diversity of research designs, types of data, types and levels of PCMH

accreditation, implementation lengths, study lengths, population age ranges, target populations, sample sizes, outcome measures, and more. In this context, more reliable and consistent results are needed to provide direction for future policymaking to change primary healthcare delivery in the United States. This literature review, therefore, assessed the existing literature on PCMH and its associations with healthcare utilization and expenditures to understand how PCMH impacts real-world healthcare settings, seeking to provide direction for future studies and policy efforts.

2. Methodology

In this literature review, the evidence was not limited to specific study designs (e.g., experimental design, observational design, etc.); for that reason, the review may show variances in the results on PCMH and its associations with healthcare utilization and expenditures. Notably, however, this review included PCMH accreditation in the inclusion criteria and excluded studies that used constructed PCMH and thus addressed only some PCMH characteristics. This approach ensured that only actual PCMH and its associations with healthcare utilization and expenditures were included. While no PCMH accreditation standard exists, most studies included in this literature review used NCQA PCMH accreditation. More details are discussed later in this section.

The target audience for this review is the general population because public recognition is crucial in proper PCMH operation; without public understanding and participation, PCMH cannot work as designed. Public recognition is also necessary to secure policymaker support for transitioning primary care to the PCMH model. Achieving that recognition requires an understanding of the implications and significance

of PCMH and its associations with healthcare utilization and expenditures. Since policymakers are not experts in the area under study, this review was written in a way appropriate for the general population as a target audience.

This review aimed to determine whether PCMH is negatively associated with avoidable healthcare utilization and expenditures on a nationally representative scale, as well as to provide reliable, current, published literature findings. If negative associations exist, PCMH should be promoted and facilitated in situations where healthcare utilization and expenditures are at epidemic proportions (so long as doing so does not entail decreases in appropriate care). If no negative associations exist, analyzing which factors were inhibitors would be necessary and would enable the PCMH model to be implemented as intended, which can change healthcare outcomes.

This review employed the following inclusion criteria. First, English-language studies were included since they were only interpretable. Second, studies that used data gathered in the United States were included since this review aimed to examine PCMH and its associations with healthcare utilization and expenditures to alleviate issues in the U.S. healthcare system. Third, studies that sought to discover the association between PCMH and healthcare utilization, or the association between PCMH and healthcare expenditures were included. Finally, studies that contained accredited PCMHs were included to investigate actual PCMHs and not constructed ones that meet only some PCMH characteristics. Detailed inclusion and exclusion criteria are presented in Appendix A.

For the search of existing literature, the following databases were used: PubMed, Scopus, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane

Library, and Patient-Centered Outcomes Research Institute (PCORI). Search terms were chosen based on a review of relevant literature and related Medical Subject Headings terms. Since this study has two dependent variables, separate searches were conducted for each dependent variable in the PubMed, Scopus, and CINAHL databases. For the Cochrane Library and PCORI databases, only the search term *medical home* was used since adding other search terms significantly narrowed the search results. The exact search terms used in this review are presented in Appendix B, while Appendix C presents a flow chart of the search results and exclusions. A total of 19 articles were included in this review.

3. Findings

Twelve of the 19 studies in this review concluded that the PCMH model effectively reduces healthcare utilization and expenditures. In contrast, two studies found that, contrary to the general understanding of PCMH and its intended purpose, PCMH increases healthcare utilization and expenditures. Four other studies had mixed results where PCMH reduced some healthcare utilization and expenditure outcomes but increased other outcomes. One study was inconclusive on how PCMH affects healthcare utilization and expenditures because none of the outcomes were statistically significant. Appendix D has more detailed information about the included studies.

Despite some discrepancies, most studies showed that PCMH is associated with lower healthcare utilization and expenditures. The discrepancy could stem from the differences among the studies in terms of research designs, study power, types of data, types and levels of PCMH accreditation, implementation lengths, study lengths,

population age ranges, target populations, sample sizes, and outcome measures. These points are specifically analyzed below for the studies included in this review.

Sixteen of the 19 studies used a PCMH versus non-PCMH research design that included a PCMH group and a non-PCMH group and compared the outcomes of the two groups. Nine of the 16 studies examined healthcare practices that earned PCMH accreditation during the study period, while the other seven studies examined healthcare practices that had PCMH accreditation from the start of the study period. Three other studies used a pre- versus post-research design that included only one group and compared the outcomes of the post- and pre-PCMH accreditation states. In addition, six studies were identified as either a cross-sectional study (two studies) or a longitudinal study (four studies); the remaining 13 studies did not clearly state whether they were cross-sectional or longitudinal. Overall, the studies were of moderate quality. The inconsistencies in PCMH accreditation start points—which leads to different PCMH accreditation periods and serves as a critical factor in outcome measures—could contribute to the inconsistencies in the results reviewed.

Four of the 19 studies indicated the power of the study as limited due to either the small sample sizes for some of the outcomes (three studies) or the cross-sectional study design (one study). One study reported strong power due to having an interrupted time series study design. The remaining 14 studies did not mention or clearly state the power of the study. Therefore, to better assess the study power of the reviewed literature, the research design of each study was used to compare relative quality. For example, a study with a comparison group had a stronger study design than a study without a comparison group. If a study group and a comparison group were matched or somehow comparable at

the beginning of the study, the study design was stronger than that of a study that did not make the two groups comparable. Consequently, the seven studies with a matched or comparable comparison group design were considered stronger than the nine studies with a comparison group but no matched or comparable comparison design, which in turn were considered stronger than the three studies that did not have a comparison group. All reviewed studies were assigned a high, moderate, or low relative quality based on the respective study design.

Sixteen of the 19 studies used claims data for the analysis. The remaining three studies used different data types. One study used medical records, which is patient-level clinical data that includes more personal and associated data than claims data; another study used data from the Uniform Data System, which aggregates Federally Qualified Health Center-level administrative data that fundamentally differs from claims data; and the third study used MEPS and MOS data, which includes both patient- and practice-level data and provides a wider scope. In short, however, since most studies used claims data, the outcomes of this review are mostly dependent on the scope of such data.

Sixteen of the 19 studies used NCQA as a certifying body for PCMH accreditation. Of those studies, six specified a Level 3 NCQA PCMH accreditation, while the remaining 10 studies either had mixed levels (five studies) or did not specify the level and simply stated that the PCMH accreditation was acquired through NCQA (five studies). One other study used Level 3 NCQA PCMH accreditation, TJC PCMH accreditation, and AAAHC PCMH accreditation to analyze PCMH and its associations with healthcare utilization and expenditures. Two other studies did not use NCQA as a certifying body for PCMH accreditation. One used PCMH recognition under Arkansas's

Medicaid PCMH program; the other simply mentioned using certified PCMH, which can be NCQA PCMH, TJC PCMH, AAAHC PCMH, or a mixed format. In short, most studies used NCQA as the certifying body for PCMH accreditation, and most specified the accreditation level, which provided some consistency among the results of the reviewed literature.

Both the implementation length and the study length were analyzed because the length of implementation directly impacts the outcomes. The length of the study can include the pre- and post-implementation periods, where the pre-implementation period can be used to prepare the healthcare facilities for a smoother PCMH transition. In each study, the actual implementation length varied because of the different starting points of PCMH demonstration or accreditation. These inconsistent implementation lengths in the target population could be an underlying reason for the inconsistent outcomes across the reviewed literature.

Eight of the 19 studies specified the age range of the target population: four studies targeted people younger than 65 years old, which eliminated elderlies on Medicare (and, in some instances, Medicaid, as well as dual-eligibles); and another four studies used the target population of people over 17 years old. The remaining 11 studies either did not mention an age range or the age range was not applicable, which can mean that all ages in the populations were included.

Eight of the 19 studies focused on a specific target population. Two studies targeted the chronically ill population; five studies targeted populations with the insurance types of Medicaid (two studies), Medicare (two studies), or mixed (one study); and one study focused on the population with a USC. The remaining 11 studies either did

not mention a target population or the target population was not applicable, which can mean that all the populations in the data were included for analysis.

None of the 19 studies included the rationale for setting a specific sample size, which can strongly impact the power of the study and the credibility of the outcomes. If the sample size was not large enough to accurately analyze the PCMH model and its associations with healthcare utilization and expenditures, the findings cannot be considered reliable or trustworthy. This lack of reliability could have contributed to the inconsistencies in the reviewed literature.

Finally, some studies briefly mentioned their rationale for selecting outcome measures. For example, ER visits were commonly chosen as an outcome measure because PCMH is widely believed to lower the number of ER visits by accommodating after-hours healthcare needs through alternative measures, such as after-hours access via telephone. However, most studies did not explain the rationale for choosing outcome measures; the reason may simply be that the used outcome measures were available.

4. Validity, reliability, and generalizability

4.1. Issues of validity

To evaluate the significance of the study findings, the validity of each study must be examined. Most reviewed studies used a PCMH versus non-PCMH research design, an analysis of claims data, and NCQA as a certifying body for PCMH accreditation. The PCMH versus non-PCMH research design included two groups and compared the outcomes of the PCMH and non-PCMH groups, which is a relatively strong research design compared to the pre- versus post-research design (which includes only one group

and compares the outcomes of the post- and pre-PCMH accreditation states). In healthcare utilization and expenditure studies, using claims data for analysis is common because such data shows billed medical procedures and medications. NCQA is a widely used and trusted measure of PCMH accreditation.

Despite the similarities, some discrepancies appeared among the reviewed studies, which made it difficult to compare the results and derive a clear conclusion. Specifically, the PCMH accreditation level, the implementation length, the outcome measures, and the sample size were especially key factors in this regard because they varied among the reviewed studies and could be a source of inconsistency.

To begin, the PCMH accreditation level can impact the findings because it measures how many PCMH characteristics are present and therefore the stage of the PCMH implementation. For example, Level 3 NCQA PCMH indicates that a healthcare practice has considerably more PCMH characteristics than a practice with Level 1 NCQA PCMH. If the two levels were treated as one group, the study results could be biased because Level 3 and Level 1 groups may systematically differ and thus impact healthcare utilization and expenditures differently. Statistically significant results can be drawn from the Level 3 NCQA PCMH, while only mixed results can be drawn from the Level 1 NCQA PCMH; the latter does not present enough PCMH characteristics to significantly impact healthcare utilization and expenditures. Thus, the varied PCMH accreditation level across the reviewed studies could cause inconsistencies that lowered the internal validity.

Next, the implementation length can influence the study findings because the duration for which PCMH has been implemented could influence the outcome measures.

The longer the implementation, the more the findings can be impacted by PCMH. For example, a 3-year implementation would have a greater influence on healthcare utilization and expenditures than a 1-year implementation. In the same sense, a study with an accredited PCMH from the beginning of the study period would have a stronger impact on healthcare utilization and expenditures than the one that acquired PCMH accreditation during the period. Since this review focuses on PCMH accreditation, the period in which PCMH accreditation was present was treated as the actual PCMH implementation period, so if PCMH accreditation was obtained during the study period, then the PCMH implementation period started at that point. The implementation length varied among the reviewed studies, and the differences between PCMH accreditation start points led to varying PCMH accreditation periods, which could have significantly affected the outcome measures. Therefore, the implementation length could contribute to the inconsistency of the results in the reviewed literature, which potentially lowers the internal validity of the findings.

The outcome measures, which make up the study findings, can also influence the validity of the study. The kind of outcome measures included determines what findings will be discovered. For example, if a study measures ER visits but not PCP visits, the findings will include only ER visits. Even if PCMH decreases ER visits and increases PCP visits, the increased PCP visits cannot be identified, so the study findings will be biased toward decreased healthcare utilization. In short, the measures used influence what can be observed. Most reviewed studies did not mention a rationale for choosing their respective outcome measures, and diverse outcome measures emerged among the studies.

Therefore, outcome measures could contribute to the inconsistency in the results in the reviewed literature, which can lower the internal validity of the findings.

Lastly, the sample size can impact the validity as well: if a study does not include enough samples, then the findings can be invalid because a too-small sample size can create bias. The minimum sample size to conduct a valid study can be calculated, so this factor should be considered before the start of any study. For example, if the minimum sample size to conduct a valid study is 100, a study that included only 10 samples would be considered biased, invalidating the findings. Despite this importance, none of the reviewed studies mentioned or clearly stated a rationale for setting the sample size. If consideration was given to how the sample size could allow for valid results and the sample size was set above the minimum sample size (even if not stated clearly), then the study validity would hold; if not, the internal validity of the reviewed studies could be considered limited.

In short, among the reviewed studies, some common factors provided the consistency that validated the study findings; however, variations across the studies lowered the internal validity. The different PCMH accreditation levels, implementation lengths, and outcome measures made it difficult to establish a high validity of study findings. Nevertheless, the validity was established as moderate given the common research designs, the types of data used in the analysis, and the certifying body for PCMH accreditation—if the study sample size was set above the minimum.

4.2. Issues of reliability

In terms of reliability, the validity of a study and whether its findings are reproducible must be considered. Since the reviewed studies have moderate validity, the reliability could also presumably be moderate. However, the factors described below can impact reliability.

Most reviewed studies used claims data as the type of data for analysis, representing billed medical procedures and medications. Compared to a survey asking about a person's healthcare utilization and expenditures (which is subjective to the respondent and requires accurate recall), claims data is a more reliable and repeatable measurement, thereby increasing the reliability of the findings.

In addition, most reviewed studies used NCQA as a certifying body for PCMH accreditation; NCQA is a highly credible PCMH accreditation that provides a consistent method for granting accreditation. Standardized NCQA accreditation can thus serve as a reliable and reproducible measure, thereby increasing the reliability of the findings.

Only a few of the reviewed studies clearly stated that they used a longitudinal study design. This study design follows the same people for multiple years and observes the outcomes; the design accumulates data on the same people over time, which helps to conclude with minimum confounding effects. The lack of a longitudinal study design means that a study can lack consistency across time, decreasing the reliability of the findings.

In sum, across the reviewed studies, some factors provided reproducibility and thus supported the reliability of study findings; however, other elements across the studies could lower the reliability. Due to the lack of a longitudinal study design, the

reliability of the study findings cannot be considered high. Instead, the findings have moderate reliability given the claims data for analysis and the NCQA as a certifying body for PCMH accreditation—built on the foundation of moderate validity.

4.3. Issues of generalizability

Generalizability considers whether the study findings can be generalized to the wider population. Since most reviewed studies involved specific PCMH projects targeting specific geographic regions in a specific setting, many factors could have impacted the study findings. Each specific PCMH project had a specific PCMH accreditation and targeted a specific population. The different geographic regions could have different population characteristics, including age, race, ethnicity, and insurance types; the regions could also have different state support systems, including monetary incentives and systemized assistance or personnel education. Other than one study that used MEPS and MOS data (which are nationally representative), most reviewed studies were specific to a unique case, making it difficult to generalize the results. This specificity limited the generalizability of the study findings.

5. Gaps and future research

This literature review showed moderate validity, moderate reliability, and limited generalizability of the study findings among existing literature. Since the findings of most reviewed studies had limited generalizability, future research that can increase the generalizability is especially needed. Nationally representative data such as MEPS and MOS should therefore be used. MEPS data is highly credible, nationally representative

data that has been gathered since 1996; in 2015 and 2016, the MOS data gathered the characteristics of healthcare organizations. Since only one existing study had used MEPS and MOS data to research PCMH and its associations with healthcare utilization and expenditures, these datasets offer a rich data source with the potential to increase the generalizability of future findings.

Importantly, the validity and reliability should also be kept at a moderate level in any future studies focused on increasing the generalizability. Using MEPS and MOS data offers one way to do so because, compared to claims data, MEPS and MOS can provide more comprehensive and accurate healthcare utilization and expenditures data. MEPS and MOS data include more information about the patient and organizational characteristics, while the healthcare utilization and expenditure data are confirmed by healthcare providers for accuracy. In addition, MOS data include the PCMH certification status variable, which conveys whether the healthcare practice was a certified PCMH. Using standardized PCMH certification and not constructed PCMH can provide consistency and increase the validity and reliability of the study. Further, using a research design that compares certified PCMH versus non-PCMH can increase the validity of the study given the strong research design compared to the pre- versus post-research design.

In sum, MEPS and MOS are highly credible and nationally representative data sources that include information on PCMH accreditation and offer increased generalizability while maintaining moderate validity and reliability. Research on certified PCMH versus non-PCMH can reveal whether PCMH is vital to lowering avoidable healthcare utilization and expenditures. Therefore, future research should apply this critical approach using highly credible MEPS and MOS data.

Chapter 3: Methods

1. Data, sample, and population

1.1. Data

For this study, the MEPS was the main data source used for the analysis. The MEPS gathers data on the U.S. noninstitutionalized civilian population and estimates healthcare utilization, healthcare expenditures, payment sources, and healthcare insurance coverage on a national scale (AHRQ, 2018c). The survey has two components: the MEPS Household Component (MEPS-HC) and the MEPS Medical Provider Component (MEPS-MPC).

First administered in 1996, the MEPS-HC gathers information on survey participants' health status, socioeconomic and demographic characteristics, employment status, access to healthcare, and healthcare satisfaction (AHRQ, 2018c). Every year, a new panel of approximately 15,000 sample households is chosen (AHRQ, 2018c). Each panel originates from the National Health Interview Survey (NHIS) administered by the National Center for Health Statistics; a subsample of the households participating in the NHIS in one year is then chosen for the MEPS-HC panel for the following year (AHRQ, 2018c). The NHIS sampling frame provides a nationally representative sample of the U.S. noninstitutionalized civilian population but historically oversampled Hispanic and Black populations (AHRQ, 2018c). In 2006, the NHIS introduced a new sampling design that oversampled Asian populations (AHRQ, 2018c). However, in 2016, the NHIS implemented another new sampling design to stop oversampling Hispanic, Black, and Asian populations—a change reflected in the MEPS-HC data from 2017 onward (AHRQ, 2018b).

For the MEPS-HC panel design, five rounds of interviews are conducted covering two full calendar years, and information is collected on person-level changes among select variables (e.g., health status, health insurance coverage, healthcare utilization, and healthcare expenditures; AHRQ, 2018c). Computer-assisted personal interviewing (CAPI) technology enables data collection on each household member and a buildup of information for each of the five successive interviews (AHRQ, 2018c). All information about the MEPS-sampled household is gathered from interviews with a single respondent from the household (AHRQ, 2018c).

After the household CAPI is completed and consent is obtained from all household survey respondents, the MEPS-MPC is administered to a sample of the respondents' healthcare providers, who are contacted by telephone for information that household survey respondents could not report correctly (AHRQ, 2018c). The MEPS-MPC gathers information on when the patient (i.e., survey respondent) visited the healthcare practice, the patient's diagnosis and its procedural code, and the healthcare cost (AHRQ, 2018c). Despite providing information about healthcare providers, the MEPS-MPC is not constructed to independently produce national estimations but rather primarily serves as a source for imputation to replace or supplement the healthcare expenditure information provided by household survey respondents (AHRQ, 2018c). While MEPS-HC data are publicly accessible, MEPS-MPC data are restricted.

This study also used the MOS as a data source. Only administered in 2015 and 2016, the MOS was used to gather detailed information on healthcare organizations and their characteristics (e.g., who owns the healthcare practice, whether the healthcare practice utilizes health IT, and whether the healthcare practice utilizes clinical quality

data; AHRQ, 2018a). MOS data can be linked to MEPS-HC data. More specifically, the MOS broadened ongoing MEPS-MPC data collection efforts (AHRQ, 2018a). The broadened data collection incorporated characteristics of the healthcare providers when two conditions were met: the MEPS-HC had recognized the office-based healthcare providers as USCs, and MEPS-HC survey respondents had been examined by their USC providers in the same respective year (AHRQ, 2018a). This supplemental data collection, therefore, occurred with only a subset of office-based healthcare providers already in the MEPS-MPC sample (AHRQ, 2018a). To obtain that sample, those administering the MEPS-HC interviewed household survey respondents for their primary location of office-based USC (AHRQ, 2018a). The administrators of the MEPS-MPC then subsequently reached out to the practices where healthcare was provided to MEPS-HC respondents and identified suitable survey respondents for the MOS (AHRQ, 2018a). Despite surveying healthcare providers and their practices, the MOS did not generate an independent nationally representative sample since the MOS sample itself was drawn from the healthcare providers who examined the MEPS-HC participants (AHRQ, 2018a).

MOS data include organizational information, such as who owns the healthcare practice, the size of the practice, and the types of healthcare provided (AHRQ, 2018a). In addition, MOS data include information on whether the healthcare practice utilizes health IT; manages care and utilizes quality clinical data; and provides financial adjustments, including the number and types of insurance contracts, reimbursement measures, and compensation adjustments within the practice (AHRQ, 2018a). Importantly, MOS data include the PCMH accreditation status, the independent variable of this study, for each healthcare practice (AHRQ, 2018a).

1.2. Sample

MEPS-HC 2015 data were gathered in Rounds 3, 4, and 5 of Panel 19 and Rounds 1, 2, and 3 of Panel 20, wherein the rounds for both panels collectively covered the calendar year 2015 (AHRQ, 2017a). The MEPS-HC 2015 contains 35,427 sample participants (47.7% unweighted response rate; AHRQ, 2017a). Meanwhile, MEPS-HC 2016 data were gathered in Rounds 3, 4, and 5 of Panel 20 and Rounds 1, 2, and 3 of Panel 21, wherein the rounds for both panels collectively covered the calendar year 2016 (AHRQ, 2018c). MEPS-HC 2016 contains 34,655 sample participants (46% unweighted response rate; AHRQ, 2018c). In total, the MEPS-HC 2015 and 2016 contain 1,831 variables and 1,941 variables, respectively, providing information on demographics, survey administration, health status, person-level conditions, income status, disability status, employment status, health insurance coverage, healthcare quality, person-level healthcare utilization, and person-level healthcare expenditures (AHRQ, 2017a, 2018c).

MOS 2015 data were obtained in the same manner as the MEPS-HC 2015 data. For the MOS 2015, the general target population was people who had visited an office-based healthcare practice recognized as their USC one or more times in 2015 (AHRQ, 2017b). Whether the person had a USC was asked in Round 4 of Panel 19 and Round 2 of Panel 20 for the MOS 2015 (AHRQ, 2017b). The MOS 2015 includes data for 7,974 sample participants (77% response rate) who gave permission to contact their healthcare providers, who then completed the MOS 2015 (AHRQ, 2017b). For the MOS 2016, data were obtained in the same manner as the MEPS-HC 2016 data. The general target population for the MOS 2016 was people who had visited an office-based healthcare practice recognized as their USC one or more times in 2016 (AHRQ, 2018a). Whether

the person had a USC was asked in Round 4 of Panel 20 and Round 2 of Panel 21 for the MOS 2016 (AHRQ, 2018a). The MOS 2016 includes data for 9,137 sample participants (76% response rate) who gave permission to contact their healthcare providers and whose providers completed the MOS 2016 (AHRQ, 2018a). For both 2015 and 2016, the MOS contains 27 variables that provide information about the characteristics of the office-based USC providers who examined MEPS-HC participants in 2015 and 2016 (AHRQ, 2017b, 2018a).

1.3. Population

This study focused on the population with MCC since chronic conditions have continually been a subject of concern due to their heavy influence on rapidly increased healthcare utilization and expenditures. More specifically, the U.S. healthcare system has been heavily burdened due to the considerable challenges with the management of chronic conditions, which has remained high-priced and complicated (Farley et al., 2019). Chronic condition management occurs mostly in primary healthcare settings, which potentially offer better prevention opportunities and treatment outcomes than other healthcare settings (Farley et al., 2019), so targeting the MCC population for PCMH studies is highly appropriate. The current environment, with its rapidly aging population, means that the prevalence of chronic conditions has been steadily increasing even more than in the past, which in turn increases healthcare expenditures. Within this context, examining the certified PCMH and its associations with healthcare utilization and expenditures for the population with MCC is necessary to mitigate the current situation since rising healthcare costs have reached an epidemic level.

2. Variables

2.1. Independent variable

The independent variable for this study was the PCMH status, which was included in the MOS data. For the PCMH variable, *yes* meant the practice was accredited as a PCMH (any kind and any level), while *no* meant the practice was not an accredited PCMH (AHRQ, 2018c). Comparing PCMH with non-PCMH statuses allowed for observing the true power of an accredited PCMH, rather than the constructed PCMH with only a few combined PCMH characteristics examined in many other studies.

2.2. Dependent variables

A. Healthcare utilization

One of the main dependent variables in this study was healthcare utilization. The MEPS-HC dataset contains multiple healthcare utilization variables, including office-based provider visits, hospital outpatient department provider visits, hospital ER visits, hospital inpatient stays (yes/no, including zero-night stays; length), and prescribed medicine purchases (including the initial purchase and refills; AHRQ, 2018c). Since office-based provider visits and hospital outpatient department provider visits are differing types of outpatient healthcare use, the two were combined in this study as outpatient visits. Other healthcare utilization dependent variables were used as defined in the MEPS data documentation. Including multiple healthcare utilization variables based on the healthcare service type used enabled a detailed analysis of any associations between the certified PCMH and healthcare utilization.

B. Healthcare expenditures

The other main dependent variable of this study was healthcare expenditures. The MEPS-HC dataset contains multiple healthcare expenditure variables, including total expenditures, office-based provider expenditures, hospital outpatient department provider expenditures, hospital ER expenditures, hospital inpatient expenditures, and prescribed medicine expenditures (AHRQ, 2018c). Since office-based provider expenditures and hospital outpatient department provider expenditures both result from outpatient healthcare facilities, the two expenditure types were combined in this study as outpatient expenditures. Other healthcare expenditure dependent variables were used as defined in MEPS data documentation. Additionally, healthcare expenditure variables were analyzed using the following payment sources: total payment sources and out-of-pocket payment source (AHRQ, 2018c). Other payment sources (Medicare, Medicaid, private insurance, and others) were not included due to their collinearity with one control variable (i.e., health insurance status; AHRQ, 2018c). Including multiple healthcare expenditure variables based on the type of healthcare service and the payment sources for the related expenditures enabled a detailed analysis of any associations between the certified PCMH and healthcare expenditures.

2.3. Control variables

Factors that could influence the certified PCMH and any associations with healthcare utilization and expenditures were controlled in this study. As previously detailed in the theoretical framework (Andersen model) found in the Background section,

the controlled factors were divided into predisposing, enabling, and healthcare-needs factors.

Predisposing factors included age (18–49, 50–64, 65+); sex (male, female); race/ethnicity (non-Hispanic White only, Hispanic, non-Hispanic Black only, non-Hispanic others); marital status (married, not married, never married); and education status (no degree, general educational development [GED]/high school diploma, bachelor's/master's/doctorate/other degree; AHRQ, 2018c).

Enabling factors included health insurance coverage (uninsured, public only, any private); employment status (not employed, employed); family income poverty status (poor/near poor, low income, middle income, high income); census region (Northeast, Midwest, South, West); type of practices (independent practice, physician network owned by hospital, nonprofit/government clinics, others); and the number of PCPs working at the practice (0–1, 2–4, 5–10, 11+; AHRQ, 2018c).

Healthcare-needs factors included perceived health status (poor, fair, good, very good, excellent) and the number of chronic conditions (high blood pressure, coronary heart disease, angina/angina pectoris, heart attack/myocardial infarction, other kind of heart disease, stroke, emphysema, chronic bronchitis, high cholesterol, cancer, diabetes, joint pain, arthritis, and asthma; AHRQ, 2018c).

3. Study design

For the analysis of any associations between the certified PCMH and healthcare utilization and expenditures for the population with MCC, a retrospective observational cross-sectional analysis was performed. Since some healthcare utilization and

expenditure dependent variables had large proportions of zeros, a two-part analysis was used; that analysis is discussed in the following section. To increase the sample size, MEPS 2015, MEPS 2016, MOS 2015, and MOS 2016 data were used to pool 2 years of data for this study. The MOS data included the independent variable, and the MEPS data included the dependent variables; therefore, the MEPS and MOS data were merged, and then only samples with both MEPS and MOS data were used. In addition, only samples where respondents had at least one or more visits to office-based providers, a condition required for the original MOS data collection, were kept.

4. Statistical analysis

This study used the hurdle model to analyze the healthcare utilization dependent variables. The first part of the hurdle model for this study was the probit model, and the second part was the truncated Poisson model, accounting for the complex survey design. Initially introduced by Mullahy in 1986, the hurdle model has been commonly used for count data analysis since healthcare utilization can be decided in two-part processes (Farbmacher, 2011). For instance, the initial contact is determined by a patient's decision to visit a healthcare facility, and then a doctor affects the intensity and frequency of the treatment (Farbmacher, 2011). In this multi-step mechanism, using only a single-step count data model would be inappropriate, so the hurdle model has commonly been applied in such processes (Farbmacher, 2011). The first part of the hurdle model has usually been a binary model to capture the participation itself—for instance, capturing the patient’s determination to visit a healthcare facility (Farbmacher, 2011). The second part of the model has typically been a zero-truncated model to capture the intensity of

participation only for those who participated in the first part—for example, capturing the number of visits to the doctor's office (Farbmacher, 2011). Unlike the single-step count data model, the hurdle model allows for heterogeneity among the people above or below the hurdle (Farbmacher, 2011). Frequently, the hurdle has been placed at zero, which helps deal with the excess zero problems that occur when more zeros are present compared to predictions by the single-step count data model (Farbmacher, 2011). The hurdle model has merits theoretically and, in many applications, has performed better than the single-step count data model (Farbmacher, 2011). Therefore, the hurdle model was used in this study to analyze the healthcare utilization dependent variables.

Similarly, this study used the two-part model for the analysis of the healthcare expenditure dependent variables. The first part was the probit model, and the second part was the generalized linear model with a log link and a gamma distribution, accounting for the complex survey design. The two-part model, a counterpart of the hurdle model, has been frequently used to analyze healthcare expenditures with continuous outcomes (Belotti et al., 2015). For example, when a person has a disease or a healthcare condition, medical care is required, thus producing positive healthcare expenditures (Belotti et al., 2015). In such cases, the two-part model enables the censoring process and therefore applies different processes for the cases of zeros and non-zeros (Belotti et al., 2015). The first part of the two-part model has typically been a binary model, which works well for examining zeros versus non-zeros (positives; Belotti et al., 2015). The second part has typically been a regression model, which works well for the analysis of non-zeros (positives; Belotti et al., 2015). Since the two-part model is appropriate for continuous

outcomes with mass zeros, the model was used in this study to analyze the healthcare expenditure dependent variables.

All statistical analyses in this study were performed using STATA 16 software, and a p-value < .05 was considered statistically significant. Since this study included multiple dependent variables and conducted multiple tests, the Bonferroni corrected p-value was reported to adjust for the multiple comparisons problem, which creates an increased risk of Type □ error (false positive). For the individual hurdle model and two-part model in Table 4, the Bonferroni corrected p-value < .005 was statistically significant and has an asterisk. For the combined format of the hurdle model and two-part model in Table 5, the Bonferroni corrected p-value < .01 is statistically significant and has an asterisk.

Chapter 4: Results

1. Operationalization of variables

Table 1 shows the name, definition, operationalization, and data source of the variables used in this study. Starting with the predisposing factors, the age variable was originally continuous in the MEPS data, but for this study, age was categorized into three groups: *18–49, 50–64*, and *65+*. This categorization was used to allow for considering the elderly population separately and to recognize that most chronic condition variables were collected for people older than 17 years old. The population aged 0–17 years was excluded from the analysis of this study. The race/ethnicity variable originally had five groups in the MEPS data—*Hispanic, non-Hispanic White only, non-Hispanic Black only, non-Hispanic Asian only,* and *non-Hispanic other race or multiple race*—but for this study, race/ethnicity was categorized into four groups by combining the *non-Hispanic Asian only* group and *non-Hispanic other race or multiple race* group into the *non-Hispanic others* group. This categorization was used due to the small sample sizes of these groups, which could have hindered the statistical analysis using the hurdle and two-part models. Likewise, the marital status variable originally had six groups in the MEPS data, but for this study, marital status was categorized into three groups—*married, not married,* and *never married*—by combining the *widowed*, *divorced*, and *separated* groups into the *not married* group. This categorization was due to the small sample sizes of these groups, which could have hindered the statistical analysis using the hurdle and two-part models. The education status variable originally had eight groups in the MEPS data, but for this study, education status was categorized into three groups—*no degree, GED/high school diploma,* and *bachelor/master/doctorate/other degree*—by combining *GED* and

high school diploma groups into the *GED/high school diploma* group, and by combining the *bachelor's degree*, *master's degree*, *doctorate degree*, and *other degree* groups into the *bachelor/master/doctorate/other degree* group. This categorization was used to consider education status at three levels (no degree, GED/high school diploma, and higher education), which is appropriate for the analysis of PCMH and its associations with healthcare utilization and expenditures according to the relevant literature.

Among enabling factors, the employment status variable originally had three groups in the MEPS data, but for this study, employment status was categorized into two groups—*not employed* and *employed*—by incorporating the *job to return to* group into the *employed* group. This categorization was used to consider employment status at two levels (not employed and employed), which is appropriate for the analysis of PCMH and its associations with healthcare utilization and expenditures according to the relevant literature. The family income poverty status variable originally had five groups in the MEPS data, but for this study, family income poverty status was categorized into four groups—*poor/near-poor, low income, middle income,* and *high income*—by combining the *poor/negative* and *near-poor* groups into the *poor/near-poor* group. This categorization was used due to the small sample sizes of these groups, which could have hindered the statistical analysis using the hurdle and two-part models. The type of practices variable originally had seven groups in the MOS 2015 and nine groups in the MOS 2016 data, but for this study, the type of practices was categorized into four groups—*independent practice, physician network owned by hospital, non-profit/government clinics,* and *others*—by combining the *practice owned by academic medical center*, *HMO*, *corporation owned*, and *other* groups into the *others* group. This

categorization was used due to the small sample sizes of these groups, which could have hindered the statistical analysis using the hurdle and two-part models. Notably, the *independent practice* group for this study included the *independent practice* category from MOS 2015 and *independent practice*, *owned by physicians in another practice*, and *inapplicable (owned by physicians in practice)* categories from MOS 2016 due to the modification of the data-gathering pattern of the type of practices variable. The number of PCPs variable was originally continuous in the MOS data, but for this study, the number of PCPs was categorized into four groups: *0–1*, *2–4*, *5–10*, and *11+*. This categorization was used to consider the capacity of the healthcare facility, where those with a high number of PCPs tend to be big hospitals and those with a small number of PCPs tend to be small practices.

Lastly, for healthcare-needs factors, the number of chronic conditions variable was constructed by counting the number of chronic conditions a person ever had from the following list: high blood pressure, coronary heart disease, angina/angina pectoris, heart attack/myocardial infarction, other kind of heart disease, stroke, emphysema, chronic bronchitis, high cholesterol, cancer, diabetes, joint pain, arthritis, and asthma. This continuous variable was included in this study to consider the differences among people with different numbers of chronic conditions for PCMH and its associations with healthcare utilization and expenditures. Even though this study targets the population with MCC, differences can still exist depending on the number of chronic conditions among those in the target population.

Other variables not mentioned in this section used the original categorization found in the MEPS and MOS data.

Table 1. Name, definition, operationalization, and data source of variables

	Variable name and definition	Original description	Operationalization in this study	Data source
Independent variable				
PCMH	*MEDHOME*: Certified Patient-centered Medical Home	1: Yes 2: No	0: No 1: Yes	MOS
Dependent variables				
<Healthcare utilization>				
	SUMTOTV15: OBTOTV15 + OPTOTV15 *SUMTOTV16: OBTOTV16 + OPTOTV16*	NA	Continuous	Constructed
Outpatient visits	*OBTOTV15*: Number of office-based provider visits in 2015 *OBTOTV16*: Number of office-based provider visits in 2016	Continuous	NA	MEPS
	OPTOTV15: Number of outpatient department provider visits in 2015 *OPTOTV16*: Number of outpatient department provider visits in 2016	Continuous	NA	MEPS
Hospital ER visits	*ERTOT15*: Number of ER visits in 2015 *ERTOT16*: Number of ER visits in 2016	Continuous	Continuous	MEPS
Hospital inpatient stays (Yes/No)	*IPDIS15*: Number of hospital discharges in 2015 *IPDIS16*: Number of hospital discharges in 2016	Continuous	Continuous	MEPS
Hospital inpatient stays (Length)	*IPNGTD15*: Number of nights in hospital for discharges in 2015 *IPNGTD16*: Number of nights in hospital for discharges in 2016	Continuous	Continuous	MEPS
Prescribed medicine	*RXTOT15*: Number of prescribed medicines including refills in 2015 *RXTOT16*: Number of prescribed medicines including refills in 2016	Continuous	Continuous	MEPS
<Healthcare expenditures>				
A. Total payment sources				
Total expenditures	*TOTEXP15*: Total healthcare expenditure in 2015 *TOTEXP16*: Total healthcare expenditure in 2016	Continuous	Continuous	MEPS
Outpatient expenditures	*SUMEXP15: OBVEXP15 + OPTEXP15*	NA	Continuous	Constructed

	SUMEXP16: OBVEXP16 + OPTEXP16			
	OBVEXP15: Total office-based expenditures in 2015 *OBVEXP16*: Total office-based expenditures in 2016	Continuous	NA	MEPS
	OPTEXP15: Total outpatient facility and doctor expenditures in 2015 *OPTEXP16*: Total outpatient facility and doctor expenditures in 2016	Continuous	NA	MEPS
Hospital ER expenditures	*ERTEXP15*: Total ER facility and doctor expenditures in 2015 *ERTEXP16*: Total ER facility and doctor expenditures in 2016	Continuous	Continuous	MEPS
Hospital inpatient expenditures	*IPTEXP15*: Total hospital inpatient facility and doctor expenditures in 2015 *IPTEXP16*: Total hospital inpatient facility and doctor expenditures in 2016	Continuous	Continuous	MEPS
Prescribed medicine expenditures	*RXEXP15*: Total prescribed medicines expenditures in 2015 *RXEXP16*: Total prescribed medicines expenditures in 2016	Continuous	Continuous	MEPS
B. Out-of-pocket payment source				
Total expenditures	*TOTSLF15*: Total amount paid by self/family in 2015 *TOTSLF16*: Total amount paid by self/family in 2016	Continuous	Continuous	MEPS
	SUMSLF15: OBVSLF15 + OPTSLF15 *SUMSLF16: OBVSLF16 + OPTSLF16*	NA	Continuous	Constructed
Outpatient expenditures	*OBVSLF15*: All office visits – self/family amounts in 2015 *OBVSLF16*: All office visits – self/family amounts in 2016	Continuous	NA	MEPS
	OPTSLF15: All outpatient department visits – self/family amounts (facility and doctor) in 2015 *OPTSLF16*: All outpatient department visits – self/family amounts (facility and doctor) in 2016	Continuous	NA	MEPS
Hospital ER expenditures	*ERTSLF15*: ER – self/family amounts (facility and doctor) in 2015 *ERTSLF16*: ER – self/family amounts (facility and doctor) in 2016	Continuous	Continuous	MEPS
Hospital inpatient expenditures	*IPTSLF15*: Inpatient hospital stays – self/family amounts (facility and doctor) in 2015 *IPTSLF16*: Inpatient hospital stays – self/family amounts (facility and doctor) in 2016	Continuous	Continuous	MEPS
Prescribed medicine expenditures	*RXSLF15*: Total prescribed medicines – self/family amounts in 2015	Continuous	Continuous	MEPS

	RXSLF16: Total prescribed medicines – self/family amounts in 2016			
Control variables				
<Predisposing factors>				
Age	*AGE15X*: Age as of 12/31/15 *AGE16X*: Age as of 12/31/16	Continuous	1: 18–49 2: 50–64 3: 65+	MEPS
Gender	*SEX*: Sex	1: Male 2: Female	1: Male 2: Female	MEPS
Race/ethnicity	*RACETHX*: Race/ethnicity	1: Hispanic 2: Non-Hispanic White only 3: Non-Hispanic Black only 4: Non-Hispanic Asian only 5: Non-Hispanic other race or multiple race	1: Non-Hispanic White only 2: Hispanic 3: Non-Hispanic Black only 4: Non-Hispanic others	MEPS
Marital status	*MARRY15X*: Marital status – 12/31/15 *MARRY16X*: Marital status – 12/31/16	1: Married 2: Widowed 3: Divorced 4: Separated 5: Never married 6: Under16 – inapplicable	1: Married 2: Not married 3: Never married	MEPS
Education status	*HIDEG*: Highest degree when first entered MEPS	1: No degree 2: GED 3: High school diploma 4. Bachelor's degree 5: Master's degree 6: Doctorate degree 7: Other degree	1: No degree 2: GED/High school diploma 3: Bachelor/Master/Doctorate/Other degree	MEPS

		8: Under 16 – inapplicable		
<Enabling factors>				
Health insurance coverage	*INSCOV15*: Health insurance coverage indicator in 2015 *INSCOV16*: Health insurance coverage indicator in 2016	1: Any private 2: Public only 3: Uninsured	1: Uninsured 2: Public only 3: Any private	MEPS
Employment status	*EMPST42H*: Employment status at Round 4 / Round 2	1: Employed at Round 4 / Round 2 initial date 2: Job to return to at Round 4 / Round 2 initial date 34: Not employed during Round 4 / Round 2	1: Not employed 2: Employed	MEPS
Family income poverty status	*POVCAT15*: Family income as percent of poverty line – categorical *POVCAT16*: Family income as percent of poverty line – categorical	1: Poor/negative 2: Near-poor 3: Low income 4: Middle income 5: High income	1: Poor/near-poor 2: Low income 3: Middle income 4: High income	MEPS
Census Region	*REGION15*: Census region as of 12/31/15 *REGION16*: Census region as of 12/31/16	1: Northeast 2: Midwest 3: South 4: West	1: Northeast 2: Midwest 3: South 4: West	MEPS
Type of practices	*PRACTYPX*: Practice description	-1: Inapplicable (Owned by physicians in practice; 2016) 1: Independent practice 2: Physician network owned by hospital 3: Non-profit or government clinic 4: Practice owned by academic medical center 5: HMO 6: Corporation owned (2015)	1: Independent practice 2: Physician network owned by hospital 3: Non-profit/government clinics 4: Others	MOS

		7: Owned by physicians in another practice (2016) 8: Corporation owned (2016) 91: Other		
Number of PCPs	*NUMPCP*: Approximate number of primary care physicians in practice	Continuous	1: 0-1 2: 2-4 3: 5-10 4: 11+	MOS
<Healthcare-needs factors>				
Perceived health status	*RTHLTH42*: Perceived health status – Round 4 / Round 2	1: Excellent 2: Very good 3: Good 4: Fair 5: Poor	1. Poor 2. Fair 3: Good 4: Very good 5: Excellent	MEPS
Number of chronic conditions	*CHRONIC*: Number of chronic conditions that a person ever had among high blood pressure, coronary heart disease, angina/angina pectoris, heart attack/myocardial infarction, other kind of heart disease, stroke, emphysema, chronic bronchitis, high cholesterol, cancer, diabetes, joint pain, arthritis, and asthma	NA	Continuous	Constructed
[Chronic conditions]				
High blood pressure	*HIBPDX*: High blood pressure diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Coronary heart disease	*CHDDX*: Coronary heart disease diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Angina/angina pectoris	*ANGIDX*: Angina diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Heart attack/myocardial infarction	*MIDX*: Heart attack (MI) diagnosis (>17)	1: Yes	0: No	MEPS

		2: No	1: Yes	
Other kind of heart disease	*OHRTDX*: Other heart disease diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Stroke	*STRKDX*: Stroke diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Emphysema	*EMPHDX*: Emphysema diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Chronic bronchitis	*CHBRON53*: Chronic bronchitis last 12 Months (>17) – Round 5 / Round 3	1: Yes 2: No	0: No 1: Yes	MEPS
High cholesterol	*CHOLDX*: High cholesterol diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Cancer	*CANCERDX*: Cancer diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Diabetes	*DIABDX*: Diabetes diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Joint pain	*JTPAIN53*: Joint pain last 12 months (>17) – Round 5 / Round 3	1: Yes 2: No	0: No 1: Yes	MEPS
Arthritis	*ARTHDX*: Arthritis diagnosis (>17)	1: Yes 2: No	0: No 1: Yes	MEPS
Asthma	*ASTHDX*: Asthma diagnosis	1: Yes 2: No	0: No 1: Yes	MEPS

ER: Emergency Room
GED: General Educational Development
HMO: Health Maintenance Organization
MEPS: Medical Expenditure Panel Survey
MOS: Medical Organizations Survey
NA: Not Applicable
PCMH: Patient-centered Medical Home
PCPs: Primary Care Physicians

2. Variable distribution by non-PCMH versus certified PCMH for the population with MCC

Table 2 shows the distribution of categorical variables by non-PCMH versus certified PCMH for the population with MCC. Most variables showed no significant differences between the two groups. However, the gender, census region, type of practices, and number of PCPs variables had a *p*-value of < .05, which means that the distribution of categorical variables by non-PCMH versus certified PCMH for the population with MCC significantly differed. Compared to non-PCMHs, certified PCMHs were more likely to include *woman* than *man*; *Northeast* and *Midwest* regions than *South* and *West* regions; *physician network owned by hospital*, *non-profit government clinics*, and *others* practice types than *independent practice*; and *5–10* and *11+* PCPs than *0–1* and *2–4* PCPs. These variables were controlled in the analysis to account for the initial differences.

Table 3 shows the distribution of continuous variables by non-PCMH versus certified PCMH for the population with MCC. Most variables had no significant differences between the two groups. However, the *number of chronic conditions* and *prescribed medicines* for healthcare utilization variables had a *p*-value of < .05, which means that the distribution of the continuous variables by non-PCMH versus certified PCMH for the population with MCC significantly differed. Compared to non-PCMHs, certified PCMHs were more likely to have fewer chronic conditions and fewer prescribed medicine purchases. The number of chronic conditions variable was controlled in the analysis to account for the initial differences.

Table 2. Distribution of categorical variables by non-PCMH vs. certified PCMH for the population with MCC

	Non-PCMH (%)	Certified PCMH (%)	*p*-value
<Predisposing factors>			
Age (years)			0.0533
18–49	19.69	22.40	
50–64	35.22	37.42	
65+	45.09	40.18	
Gender			0.0016*
Male	46.21	40.98	
Female	53.79	59.02	
Race/ethnicity			0.9003
Non-Hispanic White only	72.99	73.85	
Hispanic	10.72	10.03	
Non-Hispanic Black only	9.99	10.13	
Non-Hispanic others	6.30	5.99	
Marital status			0.9088
Married	58.61	58.38	
Not married	30.09	29.78	
Never married	11.30	11.84	
Education status			0.3275
No degree	14.47	12.89	
GED/High school diploma	46.66	49.87	
Bachelor/Master/Doctorate/Other degree	38.87	37.24	
<Enabling factors>			
Health insurance coverage			0.1164
Uninsured	2.39	3.56	

Public only	31.41	32.73	
Any private	66.20	63.71	
Employment status			0.5225
Not employed	54.94	53.61	
Employed	45.06	46.39	
Family income poverty status			0.4412
Poor/Near poor	15.91	16.86	
Low income	12.44	14.24	
Middle income	27.25	27.02	
High income	44.40	41.89	
Census region			0.0053*
Northeast	16.98	22.22	
Midwest	19.02	25.73	
South	42.23	31.57	
West	21.77	20.47	
Type of practices			0.0000*
Independent practice	59.47	42.28	
Physician network owned by hospital	21.84	25.20	
Non-profit government clinics	9.47	19.51	
Others	9.22	13.01	
Number of PCPs			0.0000*
0-1	39.64	17.09	
2-4	33.86	31.60	
5-10	14.88	26.07	
11+	11.61	25.24	

<Healthcare needs factors>

Perceived health status			0.7728
Poor	5.98	5.69	
Fair	18.87	17.06	
Good	34.01	35.59	
Very good	29.71	30.05	
Excellent	11.43	11.61	

*Significant at *p*-value < .05 level
GED: General Educational Development
MCC: Multiple Chronic Conditions
PCMH: Patient-centered Medical Home
PCPs: Primary Care Physicians

Table 3. Distribution of continuous variables by non-PCMH vs. certified PCMH for the population with MCC

	Mean (#/$)	Linearized SE	95% CI		*p*-value
<Healthcare needs factors>					
Number of chronic conditions					
Non-PCMH	4.00	0.06	3.88	4.12	0.011*
Certified PCMH	3.82	0.04	3.74	3.90	
<Healthcare utilization>					
Outpatient visits					0.609
Non-PCMH	13.05	0.37	12.31	13.79	
Certified PCMH	13.35	0.48	12.40	14.29	
Hospital ER visits					0.767
Non-PCMH	0.34	0.03	0.29	0.40	
Certified PCMH	0.33	0.02	0.29	0.38	
Hospital inpatient stays (Yes/No)					0.133
Non-PCMH	0.23	0.03	0.17	0.30	
Certified PCMH	0.18	0.01	0.15	0.21	
Hospital inpatient stays (length)					0.150
Non-PCMH	1.09	0.15	0.79	1.38	
Certified PCMH	0.84	0.09	0.66	1.01	
Prescribed medicines					0.002*
Non-PCMH	30.24	0.78	28.69	31.78	
Certified PCMH	26.96	0.82	25.33	28.59	
<Healthcare expenditures>					
A. Total payment sources					
Total expenditures					0.106

Non-PCMH	11,613.29	541.85	10,544.84	12,681.74	
Certified PCMH	10,443.47	558.99	9,341.23	11,545.70	
Outpatient expenditures					0.399
Non-PCMH	3,231.02	127.98	2,978.66	3,483.38	
Certified PCMH	3,428.18	213.65	3,006.89	3,849.47	
Hospital ER expenditures					0.204
Non-PCMH	306.97	25.55	256.59	357.35	
Certified PCMH	404.20	76.40	253.55	554.84	
Hospital inpatient expenditures					0.188
Non-PCMH	3,080.71	312.13	2,465.24	3,696.18	
Certified PCMH	2,570.14	247.12	2,082.87	3,057.41	
Prescribed medicines expenditures					0.101
Non-PCMH	3,563.63	218.32	3,133.14	3,994.13	
Certified PCMH	2,991.41	288.41	2,422.71	3,560.11	
B. Out-of-pocket payment source					
Total expenditures					0.751
Non-PCMH	1,195.16	52.36	1,091.92	1,298.41	
Certified PCMH	1,170.87	58.08	1,056.34	1,285.39	
Outpatient expenditures					0.621
Non-PCMH	372.32	19.03	334.79	409.85	
Certified PCMH	357.85	22.39	313.70	402.01	
Hospital ER expenditures					0.428
Non-PCMH	21.68	4.28	13.23	30.12	
Certified PCMH	27.38	5.90	15.75	39.01	
Hospital inpatient expenditures					0.320
Non-PCMH	46.88	8.76	29.60	64.16	

Certified PCMH	67.24	18.44	30.88	103.59	
Prescribed medicines expenditures					0.843
Non-PCMH	380.26	19.89	341.04	419.48	
Certified PCMH	387.63	31.53	325.46	449.80	

*Significant at *p*-value < .05 level
CI: Confidence Interval
ER: Emergency Room
MCC: Multiple Chronic Conditions
PCMH: Patient-centered Medical Home
SE: Standard Error

3. Adjusted regression results by PCMH status for the population with MCC using the hurdle and two-part models

Table 4 shows the adjusted regression results by PCMH status for the population with MCC using the hurdle and two-part models. Table 5 shows the adjusted regression results by PCMH status for the population with MCC using the hurdle and two-part models in a combined format. The total population was 4,213, which represents a weighted population of about 39.3 million U.S. adults aged 18 years and older with MCC.

A. Dependent variable: Healthcare utilization

Individuals with MCC who reported at least one hospital ER visit and whose usual source of primary care was a certified PCMH reported 0.24 more hospital ER visits (*p*-value = .049) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus. However, the association between PCMH-based primary care and hospital ER visits was not statistically significant at the Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER visits by PCMH status for the population with MCC using the hurdle model in combined format (Bonferroni corrected level of 0.01).

Individuals with MCC who reported at least one prescribed medicine purchase and whose usual source of primary care was a certified PCMH reported 3.60 fewer prescribed medicine purchases (p-value = .003) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris

paribus. Also, the association between PCMH-based primary care and prescribed medicine purchases was statistically significant at the Bonferroni-corrected level of 0.005. This result aligns with the result in Table 5, which shows that individuals with MCC whose usual source of primary care was a certified PCMH reported 3.50 fewer prescribed medicine purchases (p-value = .002) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus, using the hurdle model in combined format (Bonferroni corrected level of 0.01).

Other results did not show statistically significant differences between non-PCMH and certified PCMH for this population.

B. Dependent variable: Healthcare expenditures

Individuals with MCC who reported any hospital ER expenditures from total payment sources and whose usual source of primary care was a certified PCMH reported $571.45 more hospital ER expenditures from total payment sources (*p*-value = .022) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus. However, the association between PCMH-based primary care and hospital ER expenditures from total payment sources was not statistically significant at the Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER expenditures from total payment sources by PCMH status for the population with MCC using the two-part model in combined format (Bonferroni corrected level of 0.01).

Individuals with MCC who reported any hospital ER expenditures from the out-of-pocket payment source and whose usual source of primary care was a certified PCMH reported $127.15 more hospital ER expenditures from the out-of-pocket payment source (*p*-value = .011) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus. However, the association between PCMH-based primary care and hospital ER expenditures from out-of-pocket payment source was not statistically significant at the Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER expenditures from the out-of-pocket payment source by PCMH status for the population with MCC using the two-part model in combined format (Bonferroni corrected level of 0.01).

Other results did not show statistically significant differences between non-PCMH and certified PCMH for this population.

Table 4. Adjusted regression results by PCMH status for the population with MCC using the hurdle model/two-part model (Subpopulation number of observation = 4,213, Subpopulation size = 39,264,465.3)

	Two-part model	dy/dx	Linearized SE	t	*p*-value	95% CI	
<Healthcare utilization>							
Outpatient visits	Probit	.	.	.	.	.	.
	Truncated Poisson	-0.37	0.63	-0.59	0.557	-1.61	0.87
Hospital ER visits	Probit	-0.03	0.02	-1.61	0.109	-0.06	0.01
	Truncated Poisson	0.24	0.12	1.98	0.049†	0.00	0.47
Hospital inpatient stays (Yes/No)	Probit	-0.02	0.01	-1.60	0.111	-0.04	0.00
	Truncated Poisson	0.03	0.13	0.26	0.796	-0.22	0.29
Hospital inpatient stays (Length)	Probit	-0.02	0.01	-1.41	0.160	-0.04	0.01
	Truncated Poisson	0.22	0.87	0.26	0.798	-1.50	1.95
Prescribed medicines	Probit	0.00	0.01	-0.24	0.810	-0.02	0.01
	Truncated Poisson	-3.60	1.18	-3.06	0.003*	-5.91	-1.28
<Healthcare expenditures>							
A. Total payment sources							
Total expenditures	Probit	.	.	.	.	.	.
	GLM	-795.56	676.43	-1.18	0.241	-2,129.45	538.32
Outpatient expenditures	Probit	0.00	0.00	1.52	0.129	0.00	0.00
	GLM	18.65	243.00	0.08	0.939	-460.53	497.83
Hospital ER expenditures	Probit	-0.03	0.02	-1.44	0.151	-0.06	0.01
	GLM	571.45	246.32	2.32	0.022†	85.22	1,057.68
Hospital inpatient expenditures	Probit	-0.02	0.01	-1.58	0.116	-0.04	0.00
	GLM	1,666.83	2,581.97	0.65	0.520	-3,444.85	6,778.51
Prescribed medicine expenditures	Probit	0.00	0.01	-0.29	0.775	-0.02	0.01
	GLM	-353.16	250.92	-1.41	0.161	-847.97	141.66

B. Out-of-pocket payment source

Total expenditures	Probit	0.00	0.01	0.31	0.756	-0.01	0.01
	GLM	-97.09	72.84	-1.33	0.184	-240.73	46.55
Outpatient expenditures	Probit	-0.01	0.02	-0.66	0.509	-0.05	0.02
	GLM	-25.59	38.16	-0.67	0.503	-100.85	49.67
Hospital ER expenditures	Probit	-0.01	0.01	-1.28	0.201	-0.03	0.01
	GLM	127.15	48.90	2.60	0.011†	30.07	224.22
Hospital inpatient expenditures	Probit	0.00	0.01	0.32	0.746	-0.01	0.02
	GLM	36.64	312.25	0.12	0.907	-588.18	661.45
Prescribed medicine expenditures	Probit	0.00	0.01	0.30	0.762	-0.02	0.03
	GLM	-4.99	26.96	-0.19	0.853	-58.15	48.17

*Bonferroni corrected *p*-value < .005 is statistically significant and has an asterisk.

†*p*-value < .05 level

. No analysis was conducted since only samples where respondents had at least one or more visits to office-based providers were kept.

-For healthcare utilization, probit first part and truncated Poisson second part.

-For healthcare expenditures, probit first part and GLM second part.

-dy/dx for factor levels is the discrete change from the base level.

CI: Confidence Interval

ER: Emergency Room

GLM: Generalized Linear Model

MCC: Multiple Chronic Conditions

PCMH: Patient-centered Medical Home

SE: Standard Error

Table 5. Adjusted regression results by PCMH status for the population with MCC using the hurdle model/two-part model in combined format (Subpopulation number of observation = 4,213, Subpopulation size = 39,264,465.3)

	dy/dx	Linearized SE	t	*p*-value	95% CI	
<Healthcare utilization>						
Outpatient visits	.	.	.	.	.	.
Hospital ER visits	0.03	0.03	1.06	0.288	-0.02	0.08
Hospital inpatient stays (Yes/No)	-0.01	0.02	-0.49	0.627	-0.04	0.03
Hospital inpatient stays (Length)	-0.08	0.13	-0.58	0.563	-0.33	0.18
Prescribed medicines	-3.50	1.13	-3.10	0.002*	-5.72	-1.27
<Healthcare expenditures>						
A. Total payment sources						
Total expenditures	.	.	.	.	.	.
Outpatient expenditures	22.01	242.36	0.09	0.928	-455.92	499.94
Hospital ER expenditures	75.02	52.37	1.43	0.154	-28.26	178.30
Hospital inpatient expenditures	-199.44	379.72	-0.53	0.600	-948.23	549.35
Prescribed medicine expenditures	-344.14	241.61	-1.42	0.156	-820.58	132.30
B. Out-of-pocket payment source						
Total expenditures	-93.21	71.08	-1.31	0.191	-233.38	46.95
Outpatient expenditures	-23.94	27.75	-0.86	0.389	-78.66	30.77
Hospital ER expenditures	5.56	3.81	1.46	0.146	-1.95	13.08
Hospital inpatient expenditures	4.39	15.14	0.29	0.772	-25.47	34.25
Prescribed medicine expenditures	-3.49	24.45	-0.14	0.887	-51.71	44.73

*Bonferroni corrected *p*-value < 0.01 is statistically significant and has an asterisk.

. No analysis was conducted since only samples where respondents had at least one or more visits to office-based providers were kept.

-For healthcare utilization, probit first part and truncated Poisson second part.

-For healthcare expenditures, probit first part and GLM second part.
-dy/dx for factor levels is the discrete change from the base level.
CI: Confidence Interval
ER: Emergency Room
GLM: Generalized Linear Model
MCC: Multiple Chronic Conditions
PCMH: Patient-centered Medical Home
SE: Standard Error

Chapter 5: Discussion

1. Interpretation of the results

This research used nationally representative MEPS and MOS data to examine the associations between having a certified PCMH (versus a non-PCMH) and healthcare utilization and expenditures for the population with MCC. Only one study result followed the study hypotheses outlined in the Background section.

A. Dependent variable: Healthcare utilization

Regarding the first hypothesis, the study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and an increased total number of healthcare outpatient visits —including office-based provider visits and hospital outpatient department provider visits—for the population with MCC, which did not support the hypothesis.

The second hypothesis was also not supported. The study results showed opposing directionality from the second hypothesis with some significant associations between having a certified PCMH (versus a non-PCMH) and an increased total number of hospital ER visits for the population with MCC. However, the association between PCMH-based primary care and hospital ER visits was not statistically significant at the Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER visits by PCMH status for the population with MCC using the hurdle model in combined format (Bonferroni corrected level of 0.01).

Like the first two, the third hypothesis was not supported. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and a decreased total number of hospital discharges, including zero-night stays, for the population with MCC.

The fourth hypothesis was not supported, either. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and a decreased length of hospital inpatient stays for the population with MCC.

On the other hand, the fifth hypothesis was supported. The study results showed some significant associations between having a certified PCMH (versus a non-PCMH) and a decreased total number of prescribed medicine purchases—including the initial purchase and refills—for the population with MCC. Individuals with MCC who reported at least one prescribed medicine purchase and whose usual source of primary care was a certified PCMH reported 3.60 fewer prescribed medicine purchases (p-value = .003) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus. The association between PCMH-based primary care and prescribed medicine purchases was statistically significant at the Bonferroni-corrected level of 0.005. This result aligns with the result in Table 5, which shows that individuals with MCC whose usual source of primary care was a certified PCMH reported 3.50 fewer prescribed medicine purchases (p-value = .002) than observationally identical respondents whose usual source of primary care was not a certified PCMH, ceteris paribus, using the hurdle model in combined format (Bonferroni corrected level of 0.01).

B. Dependent variable: Healthcare expenditures

a. Total payment sources

Regarding the first hypothesis, the study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and decreased total expenditures from the total payment sources for the population with MCC, which did not support the hypothesis.

The second hypothesis was also not supported. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and increased outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the total payment sources for the population with MCC.

Like the first two, the third hypothesis was not supported. The study results showed opposing directionality from the third hypothesis with some significant associations between having a certified PCMH (versus a non-PCMH) and increased hospital ER expenditures from the total payment sources for the population with MCC. However, the association between PCMH-based primary care and hospital ER expenditures from total payment sources was not statistically significant at the Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER expenditures from total payment sources by PCMH status for the population with MCC using the two-part model in combined format (Bonferroni corrected level of 0.01).

The fourth hypothesis was not supported, either. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and

decreased hospital inpatient expenditures from the total payment sources for the population with MCC.

Lastly, the fifth hypothesis was not supported. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine expenditures from the total payment sources for the population with MCC.

b. Out-of-pocket payment source

Regarding the first hypothesis, the study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and decreased total expenditures from the out-of-pocket payment source for the population with MCC, which did not support the hypothesis.

The second hypothesis was also not supported. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and increased outpatient expenditures—including office-based provider expenditures and hospital outpatient department provider expenditures—from the out-of-pocket payment source for the population with MCC.

Like the first two, the third hypothesis was not supported. The study results showed opposing directionality from the third hypothesis with some significant associations between having a certified PCMH (versus a non-PCMH) and increased hospital ER expenditures from the out-of-pocket payment source for the population with MCC. However, the association between PCMH-based primary care and hospital ER expenditures from out-of-pocket payment source was not statistically significant at the

Bonferroni-corrected level of 0.005, implying a possible false positive. This result aligns with the result in Table 5, which shows no significant differences in hospital ER expenditures from the out-of-pocket payment source by PCMH status for the population with MCC using the two-part model in combined format (Bonferroni corrected level of 0.01).

The fourth hypothesis was not supported, either. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and decreased hospital inpatient expenditures from the out-of-pocket payment source for the population with MCC.

Lastly, the fifth hypothesis was not supported. The study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine expenditures from the out-of-pocket payment source for the population with MCC.

2. Implications

As highlighted in the Literature Review section, certified PCMH (versus a non-PCMH) tends to have some significant associations with decreased healthcare utilization and expenditures. The study result showed hypothesized directionality and some significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine purchases for the population with MCC. Notably, no significant associations were found between having a certified PCMH (versus a non-PCMH) and prescribed medicine expenditures for both total payment sources and the out-of-pocket payment source for the population with MCC. Despite having decreased

prescribed medicine purchases (3.60 times less for a certified PCMH versus a non-PCMH), people do not have increased prescribed medicine expenditures. This finding could stem from the characteristics of PCMHs, which reflect on the patient's feedback to increase the quality of care. For instance, since PCMHs try to incorporate the patient's feedback to increase the quality of patient care, a certified PCMH might use newly released expensive drugs with fewer side effects for a patient. The management of chronic conditions includes long-term medications, so prescribing drugs with fewer side effects could lead to increased associations between a certified PCMH and decreased prescribed medicine purchases in a long run. Even though prescribed medicine purchases decrease when PCMH incorporates the patient's feedback and carefully manages the type and dosage of the medication, the prescribed medicine expenditures from both total payment sources and the out-of-pocket payment source can remain unchanged when combining the influences of expensive drugs with the decreased prescribed medicine purchases. In this scenario, PCMH can prevent the duplication of medication and lower the medication side effect, which can positively influence the patient's quality of care and health outcomes. Since this study did not examine the certified PCMH (versus a non-PCMH) and its associations with quality of care, the possibility of increased quality of care could not be confirmed and requires further research. However, another potential reason for some of the significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine purchases is their initial differences, which are shown in Table 3. Whether the amount of decreased prescribed medicine purchases exceeds the initial differences and remains significant, however, requires further research.

On the other hand, the study results showed opposite directionality from the hypothesis and some significant associations between having a certified PCMH (versus a non-PCMH) and increased hospital ER visits for the population with MCC. This finding aligns with some significant associations between having a certified PCMH (versus a non-PCMH) and increased hospital ER expenditures from both total payment sources and the out-of-pocket payment source for the population with MCC. However, the association between PCMH-based primary care and hospital ER visits and the associations between PCMH-based primary care and hospital expenditures from both total payment sources and the out-of-pocket payment source were not statistically significant at the Bonferroni-corrected level of 0.005, implying possible false positives. These results align with the results in Table 5, which show no significant differences in hospital ER visits and hospital ER expenditures from both total payment sources and the out-of-pocket payment source by PCMH status for the population with MCC using the two-part model in combined format (Bonferroni corrected level of 0.01). The study results were no longer supported when adjusted by Bonferroni correction and when analyzed in a combined format. These false positive results show the multiple comparisons problem and emphasize the need for adjustment when multiple dependent variables and tests are used.

In addition, the study results showed no significant associations between having a certified PCMH (versus a non-PCMH) and the remaining healthcare utilization (healthcare outpatient visits, number of hospital discharges, and length of hospital inpatient stays) and expenditures (total expenditures, outpatient expenditures, hospital inpatient expenditures, and prescribed medicine expenditures for both total payment sources and the out-of-pocket payment source) for the population with MCC. This

finding could stem from the PCMH characteristics of MOS data. As mentioned in the Methods section, the MOS asked survey participants simply whether their practices were accredited as a PCMH and did not specify the type and level of PCMH accreditation. Using only certified PCMH in this study and not constructed PCMH made from a few PCMH characteristics remains meaningful given that PCMH certification can provide accuracy and reliability, but the lack of the PCMH certification details could mean variations existed among the certified PCMHs, which could produce non-significant results. The MOS also only gathered PCMH status information and did not ask about the duration of the accreditation. In general, the longer healthcare practices participate in PCMH certification, the more likely they are to properly practice patient-centered healthcare services. The lack of PCMH accreditation duration information could mean that some variations among the PCMH practices were dependent on the duration of participation, which could produce non-significant results.

3. Contributions

This research contributes to the current state of knowledge about PCMH and its associations with healthcare utilization and expenditures in several ways. First, this research used MEPS and MOS data to analyze the PCMH and its associations with healthcare utilization and expenditures for the population with MCC on a national scale. As mentioned in the Literature Review section, most existing research used specific data that targeted a specific region or PCMH project, making it difficult to generalize the results. The current research fills this gap by using nationally representative data that,

compared to prior research, produced more generalizable results with external validity, which can be useful in future policymaking and obtaining the federal budget.

Second, this research used certified PCMH, rather than constructed PCMH, as the independent variable to analyze PCMH and its associations with healthcare utilization and expenditures for the population with MCC. Since constructed PCMH only uses some of the PCMH characteristics and the selection of these PCMH characteristics can be varied and arbitrary, constructed PCMH can also have some variations. To avoid such variations, this study used certified PCMH, which allows for a more accurate and reliable analysis (versus constructed PCMH) that can be useful in future policy efforts. Certified PCMH can also be used to underscore the need for PCMH accreditation.

Third, this research targeted the population with MCC. Since healthcare utilization and expenditures for managing chronic conditions are rising rapidly and burdening the healthcare system, targeting this population is appropriate given that managing MCC is more difficult and costly than managing a single chronic condition. The findings of this study can be applied to support better care management of populations with MCC, which can be crucial in attempts to decrease healthcare utilization and expenditures. Such decreases can then have huge policy implications.

Lastly, this research controlled for the practice type and the number of PCPs variables to adjust for possible initial different conditions among healthcare practices. For instance, if not controlled for, the initial differences of the healthcare practices can cause selection bias; large and already equipped healthcare practices are more likely to earn and have an easier time earning PCMH accreditation than small and poorly equipped practices. By adding the practice type and the number of PCPs to the analysis, the current

study controlled for this possibility, which could help generate more accurate study findings than would otherwise be possible.

3.1. Policy implications

This research revealed some significant associations between having a certified PCMH (versus a non-PCMH) and a decreased prescribed medicine purchase—including the initial purchase and refills—for the population with MCC. In combination with the study results that showed no significant associations between having a certified PCMH (versus a non-PCMH) and the prescribed medicine expenditures from both total payment sources and the out-of-pocket payment source for the population with MCC, this result can resolve the concern about the possibly expensive PCMH while allowing the population with MCC to enjoy the merits of certified PCMH. In other words, the population with MCC can enjoy the benefits of the PCMH model and even have decreased associations with prescribed medicine purchases while controlling prescribed medicine expenditures. Further, this finding can be expanded by other results with unchanged healthcare utilization and expenditures because the possible substitution with other healthcare service utilization and subsequent expenditures were controlled for.

The current environment and its rapidly aging population mean that the prevalence of chronic conditions has been steadily increasing even more than in the past, which in turn increases healthcare expenditures. Within this context, the current research targeted MCC, and the study results show that the merits of certified PCMH and decreased associations with the prescribed medicine purchases can be enjoyed without increased expenditures. Providing additional benefits while controlling expenditures is

especially important when considering future policy drives that can support the implementation and expansion of the PCMH model of care. This research confirmed the findings of existing literature that PCMH has decreased associations with prescribed medicine purchases but failed to confirm such associations with other healthcare utilization and expenditure variables. Even so, it would be possible to recommend further policy efforts in PCMH, especially with prescribed medicine purchase and management of medications.

4. Limitations

Even though this research has many contributions, some limitations also exist. To start, this study used a retrospective observational cross-sectional study design because MOS data was only gathered for 2015 and 2016. Since MOS data include the PCMH accreditation status (i.e., the crucial independent variable of this study), conducting a longitudinal analysis using a small sample size and short time-periods was inappropriate. Healthcare expenditures are long-term effects resulting from many years of PCMH efforts, which could be why most study results did not support the hypotheses. The longitudinal analysis can eliminate the baseline differences and show stable causal relationships; therefore, future research should use nationally representative longitudinal data to examine the certified PCMH and its impact on healthcare utilization and expenditures for the population with MCC to supplement and support the findings of this study.

Next, as previously mentioned, this study used the MOS data that only asked whether the healthcare practice was accredited as a PCMH, without specifying the kind,

level, and duration of the accreditation. This lack of accreditation details can generate variations among certified PCMHs, which could influence the study results. Therefore, future research should use certified PCMHs that specify the kind, level, and duration of the accreditation to ensure an accurate analysis.

In addition, this study could not determine whether the needed healthcare utilization was maintained by examining the relevant associations because MEPS and MOS data did not contain this variable. Not all decreases in healthcare utilization are desirable if they are required. Therefore, future research should examine the certified PCMH (versus non-PCMH) and its associations with the needed healthcare utilization for the population with MCC to ensure that appropriate care is provided to increase the overall quality of care.

This study also did not examine the long-term substitution effects. For instance, a certified PCMH can decrease both the development and worsening of healthcare conditions through the close management of patient health. In such cases, hospital ER expenditures can be decreased as the continuous management of chronic conditions results in long-term medication that can increase prescribed medicine expenditures. The change in total expenditures, however, can be minimal and not significant due to combining both changes. Future research should resolve this issue by applying a longitudinal study design.

Lastly, this study could not eliminate the possible selection bias. Even though this study used the type of practices and the number of PCPs to control for the initial differences, other factors can create issues related to selection bias. Such factors include types of patients (patients with strong disease management skills versus patients with

poor disease management skills), regional differences (urban versus rural), prearranged PCMH capacity (non-PCMH can perform patient-centered care without acquiring PCMH certification), and self-selection (healthcare facilities already interested in PCMH can acquire PCMH certification and self-select themselves into the study). Future research should resolve these issues by applying causal-inference approaches such as propensity-score matching, instrumental variables, and regression discontinuity designs, therefore minimizing the selection bias.

Chapter 6: Conclusions

The broken U.S. healthcare system financially burdens society. People visit their healthcare providers more often and pay more money than patients in other countries, yet the U.S. healthcare quality is less than optimal due to system inefficiencies. To mitigate this situation, a fundamental change is needed, including how care is delivered. The PCMH model is an alternative advanced healthcare delivery method that has been greatly promoted by U.S. healthcare stakeholders. PCMH delivers comprehensive care focused on the patients and helps cure and prevent healthcare conditions in the early stages to prevent the conditions from progressing to a critical stage, which often creates a high economic burden. However, the findings from the existing literature on PCMH and its associations with healthcare utilization and expenditures were inconsistent, making it difficult to draw definitive conclusions and generalize findings. To address this gap, this study examined the certified PCMH (versus non-PCMH) and its associations with healthcare utilization and expenditures for the populations with MCC using nationally representative MEPS and MOS data.

The study results showed some significant associations between having a certified PCMH (versus a non-PCMH) and decreased prescribed medicine purchases (3.60 times less) for the population with MCC, while no significant associations existed for prescribed medicine expenditures from both total payment sources and the out-of-pocket payment source.

Despite having a few limitations, this research makes many contributions to the current state of knowledge. First, this research used nationally representative MEPS and MOS data to produce more generalizable results with external validity, as compared to

existing literature. Second, this study used certified PCMH instead of the constructed PCMH to allow for a more accurate and reliable analysis. Third, the study targeted the population with MCC because managing multiple chronic conditions is more difficult and costly than managing a single chronic condition. Lastly, this study controlled for the practice characteristics to adjust for the initial different conditions and help generate more accurate study findings. These contributions can be useful in future policy efforts and in obtaining the federal budget.

To supplement and support the findings from this study, future research should use nationally representative longitudinal data to examine the certified PCMH and its impact on healthcare utilization and expenditures for the population with MCC. Future research should also use certified PCMH that specifies the kind, level, and duration of the PCMH accreditation for accurate analysis. In addition, future research should check whether the certified PCMH (versus non-PCMH) upholds the needed healthcare utilization for the population with MCC to ensure the appropriate care is provided to increase the quality of care. Lastly, future research should apply causal-inference approaches to minimize the possible section bias.

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Appendix A: Inclusion and exclusion criteria

Inclusion criteria:

-English language

-Studies that used data gathered in the United States.

-Studies that aimed to discover the association between the patient-centered medical home (PCMH) and healthcare utilization or the association between PCMH and healthcare expenditures.

-Studies that contained PCMH accreditation.

Exclusion criteria:

-Non-English language

-Studies that used data not gathered in the United States.

-Studies that were irrelevant to the question of interest.

*Studies focused only on PCMH and not on healthcare utilization or expenditures.

*Studies focused only on healthcare utilization or expenditures and not on PCMH.

*Studies focused on patient-centered care and its characteristics without focusing on PCMH.

*Studies that contained PCMH but did not focus on PCMH and its associations with healthcare utilization or expenditures.

*Studies that focused on the individual PCMH characteristics and not on the holistic PCMH.

*Studies that contained PCMH as a continuous variable (e.g., Physician Practice Connections-Research Survey (PPC-RS) scores since a high PPC-RS score does not guarantee PCMH accreditation or include all PCMH features).

*Studies that lacked a comparator or had a comparator that did not focus on PCMH and its association with healthcare utilization or expenditures.

*Studies that lacked statistical results (e.g., ongoing studies, editorials, reviews, commentaries, viewpoints, letters, interviews, statements, perspectives, news, responses, comments, etc.).

*Studies without full-text articles (e.g., conference abstracts).

-Studies that did not contain PCMH accreditation.

-Duplicate articles

Appendix B: Databases and search terms

Databases:

-PubMed

-Scopus

-Cumulative Index to Nursing and Allied Health Literature (CINAHL)

-Cochrane Library

-Patient-Centered Outcomes Research Institute (PCORI)

Search terms:

Search terms were chosen based on a review of relevant literature and the related Medical Subject Headings (MeSH) terms. Since this study has two dependent variables, separate searches were conducted for each dependent variable in the PubMed, Scopus, and CINAHL databases. For the Cochrane Library and PCORI databases, only the search term *medical home* was used since adding other search terms significantly narrowed the search results. The exact search terms used in this review are presented below.

*PubMed database search terms (dependent variable: healthcare utilization)

"Patient-Centered Care"[Mesh] AND "medical home"[all fields] AND ("Patient Acceptance of Health Care"[Mesh] OR "Health Services Needs and Demand"[Mesh] OR "Health Services Accessibility"[Mesh])

*PubMed database search terms (dependent variable: healthcare expenditure)

"Patient-Centered Care"[Mesh] AND "medical home"[all fields] AND ("Health Expenditures"[Mesh] OR "Cost-Benefit Analysis"[Mesh])

*Scopus database search terms (dependent variable: healthcare utilization)

TITLE-ABS-KEY ("Patient-Centered" AND "medical home") AND (INDEXTERMS ("Patient Acceptance of Health Care") OR INDEXTERMS ("Health Services Needs and Demand") OR INDEXTERMS ("Health Services Accessibility") OR "utilization") AND NOT DBCOLL(Medl)

*Scopus database search terms (dependent variable: healthcare expenditure)

TITLE-ABS-KEY ("Patient-Centered" AND "medical home") AND (INDEXTERMS ("Health Expenditures") OR INDEXTERMS ("Cost-Benefit Analysis") OR "economics" OR "expenditure" OR "cost-benefit") AND NOT DBCOLL(Medl)

*CINAHL database search terms (dependent variable: healthcare utilization)

MW "Patient-Centered" AND "medical home" AND MW ("Patient Acceptance of Health Care" OR "Health Services Needs and Demand" OR "Health Services Accessibility" OR "utilization")

*CINAHL database search terms (dependent variable: healthcare expenditure)

MW "Patient-Centered" AND "medical home" AND MW ("Health Expenditures" OR "Cost-Benefit Analysis" OR "economics" OR "expenditure" OR "cost-benefit")

*Cochrane Library database search terms

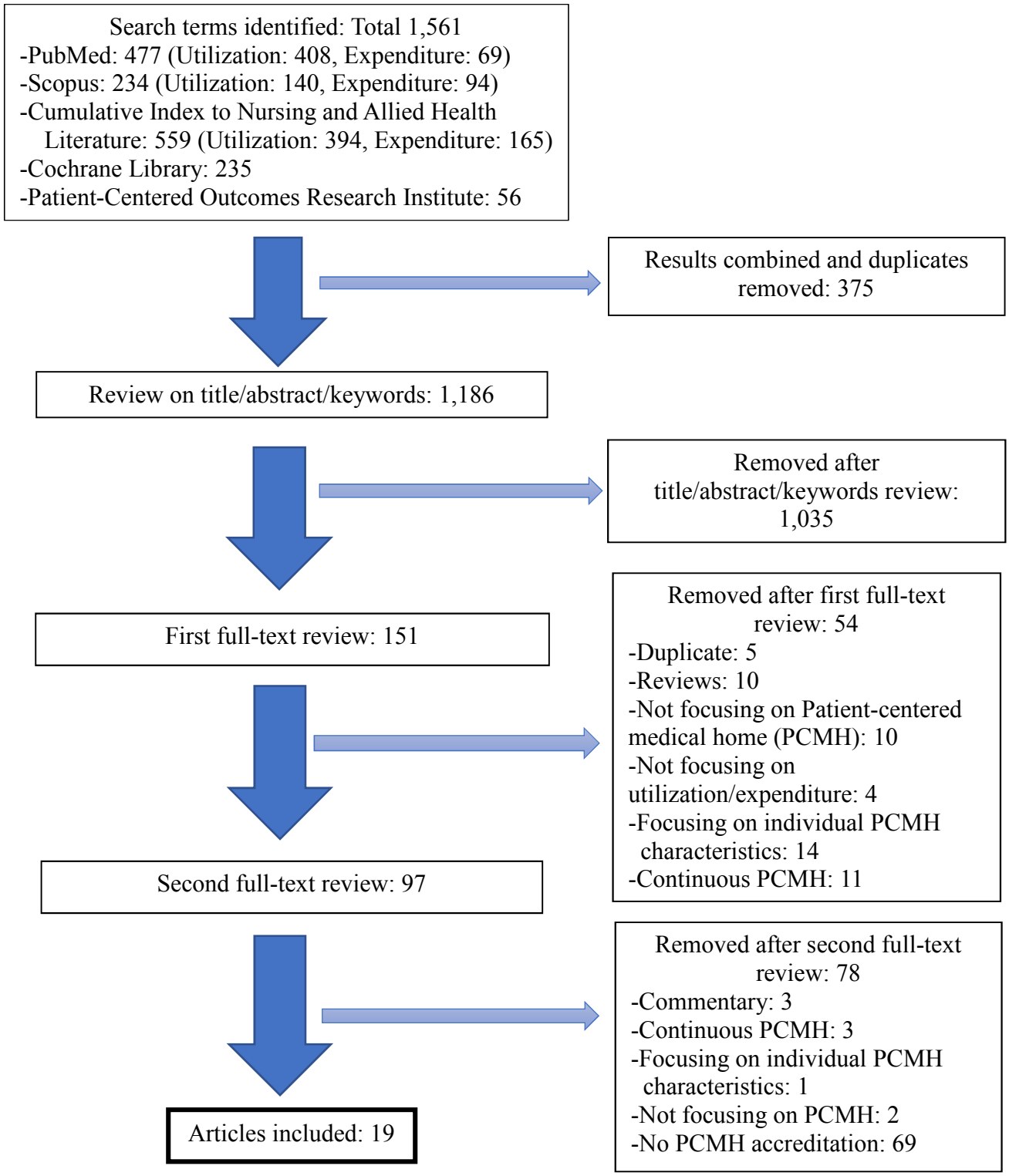
medical home

*PCORI database search terms

medical home

Appendix C: PRISMA flow chart of search results and exclusions

Search last conducted on Aug 22, 2021



Appendix D: Summary table of included literature

Author (Year)	Research designs	Types of data	Sample sizes	Age	Targe populations	Types and levels of PCMH accreditation	Outcome measures	Length of implementation	Length of study	Power of study (Quality of study from research design)
Carrillo et al. (2014)	Pre- vs. post-design 1 group : No comparison	Electronic medical record + Press Ganey patient satisfaction survey (New York State)	5,852 patients	NM	Patients with diabetes, asthma, or congestive heart failure	Level 3 NCQA PCMH recognition (From the baseline period)	ED visits: reduced by 29.7% Hospital Admissions: reduced by 28.5% 30-day readmission: reduced by 36.7% ALOS: reduced by 4.9% Short-term return on investment: 11%	3 years	4 years (Pre:1)	NM (Low)
Chattopadhyay (2021)	PCMH (transition) vs. non-PCMH (traditional FQHCs) design 2 groups : No matching	Data from Uniform Data System (FQHC-level data) (National)	Total : 1,278 FQHCs PCMH : 351 FQHCs Non-PCMH : 927 FQHCs	NA	NA	Level 3 NCQA PCMH recognition (During the study period)	Cost per visit: On average, 40% lower Cost per patient: On average, 7% lower Aggregate cost-saving impact: $1.05 billion	3 years	3 years	NM (Moderate)
Chu et al. (2017)	PCMH (transition) vs. non-PCMH	Data from Los Angeles Medicaid	<Group 1 : All clinics>	< 65 years	Medicaid beneficiaries with disabilities	NCQA PCMH recognition	<Group 1 : All clinics >	2 years	3 years (Pre: 1)	NM (High)

2 groups : Propensity score-matching	managed care plan (Member eligibility files, administrative claims data, International Classification of Diseases, procedure codes, and pharmacy claims data) (Safety net clinics) (California State)	PCMH : 2,269 patients Comparison : 21,897 patients <Group 2 : Matched on clinics> PCMH : 2,269 patients Comparison : 1,422 patients <Group 2a : with at least 1 office visit> PCMH : 1,576 patients Comparison : 846 patients <Group 2b : without any office visit> PCMH : 693 patients Comparison : 576 patients <Group 3	(From the baseline period)	OR of excess ED use: reduced by 25% <Group 2 : Matched on clinics > OR of excess ED use: reduced by 33% <Group 2a : with at least 1 office visit > OR of having at least 1 ED use: reduced by 21% OR of having excess ED use: reduced by 38% OR of acute hospitalization: reduced by 28% <Group 3 : Matched on individuals > OR of excess ED use: reduced by 28%

			: Matched on individuals> PCMH : 1,283 patients Comparison : 1,283 patients							
Cole et al. (2015)	Pre- vs. post-design 2 groups : Propensity score-matching	Louisiana Medicaid claims data (Louisiana State)	PCMH : 27 clinics Comparison : 376 clinics	NM	Medicaid beneficiaries	NCQA PCMH recognition (During the study period)	Costs and primary care use among higher proportions of chronically ill patients: reduced	4 years	4 years	NM (High)
Cole et al. (2019)	PCMH vs. non-PCMH 2 groups: Propensity score-matching	Administrative claims data (Rhode Island State)	<Cohort 1 : Intervention start date: Q2 2010> PCMH : 129,704 patients Comparison : 82,528 patients <Cohort 2 : Intervention start date: Q4 2012> PCMH : 87,291 patients Comparison : 72,279 patients <Cohort 3	≥ 18 years	NM	NCQA PCMH recognition (From the baseline period)	<Cohort 1 : Intervention start date: Q2 2010, does not have cost data> Inpatient admissions: reduced by 6.8 admissions / 1,000 patients / quarter <Cohort 2 : Intervention start date: Q4 2012> ED visits: reduced by 12.7 visits / 1,000 patients / quarter Preventable ED visits: reduced by 3.6 visits /	Cohort 1: 19Q (4 years + 3Q) Cohort 2: 9Q (2 years + Q) Cohort 3: 5Q (1 year + Q)	6 years	NM (High)

			: Intervention start date: Q4 2013> PCMH : 896,516 patients Comparison : 582,125 patients				1,000 patients / quarter Odds of having any pharmacy costs: decreased <Cohort 3 : Intervention start date: Q4 2013> ED visits: reduced by 2.4 visits / 1,000 patients / quarter Inpatient admissions: reduced by 1.7 / 1,000 admissions / quarter				
David et al. (2015)	Pre- vs. during- and pre- vs. post- design 1 group : No comparison	Data from Independence Blue Cross of Pennsylvania (Claims data) + Administrative data (Pennsylvania State)	459,676 health plan HMO members	NM	NM	NCQA PCMH recognition <Baseline period: At least Level 1 or higher> <At the end of the study period> Level 1 : 79 practices Level 2 : 23 practices	<Chronic illness> Any weekend ED visit: reduced by 6.65%~7.73% Any avoidable ED visit: reduced by 3.50~9.62% [During PCMH] Any ED visit: reduced by 2.7%~4.2% [Post PCMH]	4 years	5 years (Post: 1) (Incentive payment policy changed: Upfront financial assistance ↓ Paid based on the number of patients + Level of NCQA recognition)	NM (Low)

						Level 3 : 178 practices	Any ED visit: reduced by 5.24%~7.78%			
Friedberg et al. (2014)	PCMH (transition) vs. non-PCMH 2 groups : Propensity weighting without 1-to-1 matching Cross-sectional study	Medical claims data, prescription drug claims data, and enrollment data + Practice survey (Pennsylvania State)	PCMH : 64,243 patients Comparison : 55,959 patients	NM	NM	NCQA PCMH recognition (During the study period) Level 1 : 13 practices Level 2 : 3 practices Level 3 : 16 practices (at the end of the study period)	Rate of ACS hospitalization: greater increase	3 years	5 years (Pre:2)	NM (Moderate)
Hinde et al. (2020)	PCMH (transition) vs. non-PCMH 1 group : No comparison	Commercial claims data from the Arkansas all-payer claims database (Arkansas)	121,073 enrollees	NM	Commercially insured enrollees	PCMH recognition under Arkansas' Medicaid PCMH program (During the study period, rolling basis)	<Among early-adopting practices> Specialist visits: increased by 5.7% Primary care visit: increased by 1.5% Professional expenditures: increased by 17.6%	3 years (Rolling basis implementation)	4 years (Pre: 1)	NM (Low)
Kaushal et al. (2015)	PCMH (transition) vs. non-PCMH	Claims data + Data from the Taconic	Total : 275 PCPs (230,593 patients)	NM	NM	Level 3 NCQA PCMH recognition	<Specialist visits>	2 years	3 years (Pre: 1)	NM (Moderate)

	(paper record or only EHR) 3 groups : No matching Longitudinal study	Independent Practice Association + A comprehensive survey of physicians in the community (New York State)	PCMH : 92 PCPs EHR without PCMH : 64 PCPs Paper medical records : 119 PCPs			(During the study period)	PCMH vs. non-PCMH: reduced by 6% PCMH vs. paper: reduced by 6% PCMH vs. EHR: reduced by 6%			
Kern et al. (2016)	PCMH (transition) vs. non-PCMH (Paper record or only EHR) 3 groups : No matching Longitudinal study	Claims data + Data from the Taconic Independent Practice Association + CMS website + Data from the New York State Department of Health (New York State)	Total : 438 PCPs (136,480 patients) PCMH :125 PCPs (23,430 patients) EHR without PCMH : 87 PCPs (17,071 patients) Paper health records : 226 PCPs (35,268 patients)	≥ 18 years	NM	Level 3 NCQA PCMH recognition (During the study period)	<PCMH vs. non-PCMH> Primary care visits: increased by 7% Specialist visits: reduced by 10% Laboratory tests: reduced by 4% Radiology tests: reduced by 4% Hospitalization: reduced by 21% Rehospitalization: reduced by 57% <PCMH vs. EHR> Primary care visits: increased by 9%	4 years	5 years (Pre: 1)	NM (Moderate)

								Specialist visits: reduced by 10% Laboratory tests: reduced by 8% Radiology tests: reduced by 8% Hospitalization: reduced by 23% Rehospitalization: reduced by 60%			
Mahmud et al. (2018)	PCMH (NCQA, TJC, AAAHC) vs. non-PCMH 2 groups : No matching	Data from CMS' FQHC Advanced Primary Care Practice Demonstration (Medicare claims data) (FQHC, Safety-net clinics) (National)	Total : 1,108 FQHCs <NCQA : 393 FQHCs (232,990 beneficiaries)> PCMH : 314 FQHCs Comparison : 79 FQHCs <TJC : 100 FQHCs (55, 471 beneficiaries)> PCMH : 24 FQHCs	NM	Medicare beneficiaries receiving care at FQHCs	Level 3 NCQA PCMH recognition TJC PCMH recognition AAAHC PCMH recognition (During the study period)	<Level 3 NCQA sites> FQHC visits: increased Non-FQHC primary care visits: decreased Specialist visits: decreased over time Inpatient admissions: decreased Inpatient expenditure, Part B expenditure, and total Medicare expenditure: decreased <TJC sites>	3 years	5 years (Pre: 2)	NM (Moderate)

			Comparison : 76 FQHCs <AAAHC : 14 FQHCs (14,020 beneficiaries)> PCMH : 1 FQHC Comparison : 13 FQHCs <Not PCMH : 601 FQHCs (302,480 beneficiaries)> PCMH : 82 FQHCs Comparison : 519 FQHCs				FQHC visits: decreased Specialist visits: increased over time ED visits: decreased Inpatient admissions: decreased <AAAHC sites> FQHC visits: decreased Non-FQHC primary care visits: increased Specialist visits: increased over time ED visits: increased			
Neal et al. (2015)	PCMH (transition) vs. non-PCMH 2 groups : No matching Longitudinal study	Data from Pennsylvania chronic care initiative (Administrative medical claims data and enrollment data) (Pennsylvania State)	PCMH : 2,674 patients (11 practices) Comparison : 19,546 patients (393 practices)	NM	Chronically ill patients	NCQA PCMH recognition (During the study period)	Total, inpatient, and specialist PMPM cost: reduced ED PMPM costs: increased Utilization of hospital admissions and specialist visits: reduced	3 years	4 years (Pre: 1)	NM (Moderate)

									Utilization of ED and outpatient visits: increased			
	Reid et al. (2013)	PCMH vs. non-PCMH 2 groups : No matching, nonequivalent comparison group	Data on healthcare use from Group Health's automated clinical and administrative data system (Claims data) (Washington State and Idaho State)	412,943 patients	NM	NM		Level 3 NCQA PCMH recognition (During the study period)	Primary care office visits: reduced by 5.1% (early stabilization year) and 6.7% (late stabilization year) ED visits: reduced by 13.7% (early stabilization year) and 18.5% (late stabilization year)	3 years	4 years (Pre: 1)	Strong (Moderate)
	Rosenthal, Alidina, et al. (2015)	PCMH vs. non-PCMH 2 groups : Propensity score-matching	Administrative claims data (Rhode Island State)	Pilot : 15 practices Comparison : 66 practices	< 65 years	NM		NCQA PCMH recognition (From the baseline period) Level 2 : 3 practices Level 3 : 12 practices	ED visit: reduced by 7.9 % (2 years) and 9.3% (3 years) ED costs: reduced by 13.9% (2 years) and 11.8% (3 years) Primary care visits: reduced by 1.5% <For patients with two or more comorbidities> ED costs: reduced by 25.2% (2 years) and 14.5% (3 years)	3 years	5 years (Pre: 2)	Limited due to the small sample size (High)

							Primary care visits: reduced by 2.7% (2 years) and 1.8% (3 years) ACS inpatient admission: reduced by 10.3%			
Rosenthal et al. (2016)	PCMH (transition) vs. non-PCMH 2 groups : Propensity score-matching	Administrative claims data (New York State)	Pilot : 11 practices Comparison : 61 practices	< 65 years	NM	NCQA PCMH recognition (From the baseline period) Level 1 : 3 practices Level 3 : 8 practices	ACS ED visits: reduced by 22.6%	2 years	4 years (Pre: 2)	Limited due to the small sample size (High)
Rosenthal et al. (2013)	PCMH (transition) vs. non-PCMH 2 groups : Propensity score-matching	Administrative claims data + NCQA audit data + Interview of practice leaders (Colorado State)	Pilot : 5 practices Comparison : 34 practices	< 65 years	NM	NCQA PCMH recognition (Start: Level 1 ↓ End: Level 3) (During the study period)	ACS ED visits: reduced by 11.6%	2 years	4 years (Pre: 2)	Limited due to the small sample size (High)
Rosenthal, Sinaiko, et al. (2015)	PCMH vs. non-PCMH 2 groups : Propensity score-matching	Administrative claims data + Qualitative interview of PCMH practice leaders	Pilot : 7 practices Comparison : 61 practices	≥18 years	Patients insured through a commercial Medicare Advantage plan or Medicaid HMO plan	Level 3 NCQA PCMH recognition (From the baseline period)	ACS ED visits: reduced by 0.14% Primary care physician visits: increased by 0.01%	3 years	5 years (Pre: 2)	NM (High)

		(Ohio State)						Utilization of prescription drugs: increased by 0.01% Drug spending: reduced by 0.01% Inpatient spending: increased by 0.01%			
van Hasselt et al. (2015)	PCMH vs. non-PCMH 2 groups : Propensity weighting without matching Longitudinal study	Medicare claims data (Part A and Part B) + Medicare enrollment database + 2009 U.S. Census + The 2007 Health Resources & Services Administration and CMS utilization file + 2005 American medical association physician workforce file (National)	PCMH : 308 practices (146,410 patients) Comparison : 1,906 practices (446,273 patients)	NM	Medicare fee-for-service beneficiaries	NCQA PCMH recognition (During the study period)	ER visits for any condition: reduced by 13.5% ER visits for ACSCs: reduced by 11.3% Total annual Medicare payments: reduced by 4.9% (62% of this decline was attributable to a decline in payments to acute care hospitals)	2 years	3 years (Pre: 1)	NM (Moderate)
Xie et al. (2021)	PCMH vs. non-PCMH	MEPS and MOS linked data	Total	≥18 years	Patients with an identified USC	Certified PCMH	Total health expenditure and out-	1 year	2 years (1 + 1)	Limited due to cross-

2 groups : No matching Cross-sectional study	(National)	: 5,748 patient-provider pairs PCMH : 2,540 patient-provider pairs Non-PCMH : 3,208 patient-provider pairs	(No mention of the kind of and the level of PCMH accreditation)	of-pocket spending: No effect Inpatient stay and ED visit: No effect Any ED visits for diabetes and chronic kidney disease groups: low percentage Any ED visits for cancer subgroups: the high percentage		sectional study design (Moderate)

AAAHC: Accreditation Association for Ambulatory Health Care
ACSCs: Ambulatory Care Sensitive Conditions
CMS: Centers for Medicare & Medicaid Services
ED: Emergency Department
FQHC: Federally Qualified Health Center
MEPS: Medical Expenditure Panel Survey
NA: Not Applicable
NM: Not Mentioned
PCMH: Patient-centered Medical Home
PMPM: Per Member Per Month
TJC: The Joint Commission
ACS: Ambulatory Care Sensitive
ALOS: Average Length of Stay
DID: Difference in Differences
EHR: Electronic Health Record
HMO: Health Maintenance Organization
MOS: Medical Organizations Survey
NCQA: National Committee for Quality Assurance
OR: Odds Ratio
PCP: Primary Care Physician
Q: Quarter
USC: Usual Source of Care