PRIMARY CARE DELIVERY BY ASSOCIATE CARE PROVIDERS IN THE PATIENT CENTERED MEDICAL HOME

by

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LIST OF ACRONYMS

Abbreviation	Description
ACP	Associate care provider: includes registered nurses, licensed practical nurses, nursing assistants and technicians, pharmacists and pharmacy technicians, social workers, dietitians and nutritionists, and behavioral health providers
CBOC	Community Based Outpatient Clinic
CDW	Corporate data warehouse
CNS	Clinical nurse specialist
CPT	Current Procedural Terminology
FY	Fiscal year (October 1 – September 30)
LPN	Licensed practical nurse
MD	Medical doctor
NA	Nursing assistant; also known as CNA: certified nursing assistant
NP	Nurse practitioner
PA	Physician assistant
PACT	Patient Aligned Care Team
PCMH	Patient Centered Medical Home

Abbreviation	Description
PCMM	Primary Care Management Module
PCP	Primary care provider: includes primary care physicians, medical residents, nurse practitioners, and physician assistants
RN	Registered nurse
VA	Veterans Affairs
VAMC	Veterans Affairs Medical Center
VHA	Veterans Health Administration

GLOSSARY

Associate care provider (ACP): An ACP is a care provider that delivers primary care encounters to patients in a primary care site but does not function as a primary care provider (PCP). This may include a registered nurse (RN), licensed practical nurse (LPN), certified nursing assistant (CNA), clinical nurse specialist (CNS), clinical pharmacist, pharmacy technician, dietitian, nutritionist, social worker, and behavioral health provider.

Community Based Outpatient Clinic (CBOC): A primary care CBOC is a VA-owned or VA-leased, VA-funded or VA-reimbursed site of care that is geographically located separate from a VAMC and offers both medical and mental health care, either on site or via telehealth. A primary care CBOC has at least 500 primary care and 500 mental health encounters in a fiscal year (Department of Veterans Affairs, December 30, 2013).

Decision Support System Identifiers (DSS IDs): DSS IDs, also known as stop codes, are the single and critical designation used to identify workload for all outpatient encounters. DSS IDs define outpatient clinical work units for costing purposes, and are recorded as a six-digit descriptor. The first three numbers of the DSS ID designate the primary stop code, which refers to the clinical group responsible for the care of the patient. The last three numbers represent the secondary or credit stop code, which is a modifier that further defines the work group, such as the

type of service provided or the type of provider (Department of Veterans Affairs, May 29, 2013).

Encounter: An encounter is defined as a professional contact between a patient and a practitioner that can be face-to-face or via telephone (Department of Veterans Affairs, December 30, 2013).

Point of service: A point of service is a distinct physical location where a Veteran interacts with VA health care providers (Department of Veterans Affairs, December 30, 2013).

Primary care encounter: The VHA defines a primary care encounter as an encounter with one of the following stop codes in the primary or secondary position: 156, 157, 170-178 (home based primary care); 322, 704 (comprehensive women's health); 323 (primary care/medicine); 338 (telephone primary care); 348 (primary care shared appointment); 350 (GeriPACT: geriatrics PACT); and 531, 534, 539 (mental health primary care) (Department of Veterans Affairs, December 30, 2013).

Primary Care Management Module (PCMM): The VHA process and system that assigns patients to PCPs. Each individual patient is assigned to a single PCP at a specific primary care site for a unique period of time (Department of Veterans Affairs, April 21, 2009).

Primary care provider (PCP): A PCP is a care provider that serves as a patient's assigned provider responsible for his/her comprehensive primary care. This includes a physician, medical resident, nurse practitioner, and physician assistant.

Stop code: See Decision Support System identifiers.

Telephone encounter: A telephone contact is only considered an encounter if the contact was documented and the documentation includes elements of a face-to-face encounter, such as history and clinical decision-making (Department of Veterans Affairs, December 30, 2013).

Veterans Affairs Medical Center (VAMC): A VAMC is a VA point of service that provides at least two of the following types of care: inpatient, outpatient, residential, or institutional extended care (Department of Veterans Affairs, December 30, 2013).

ABSTRACT

INTRODUCTION: The Patient Centered Medical Home (PCMH) requires collaboration and task delegation among primary care providers (PCPs: physicians, nurse practitioners, physician assistants, and medical residents) and associate care providers (ACPs: nurses, pharmacists, social workers, dietitians, and behavioral health providers). Within PCMH, ACPs have expanded roles in clinical care delivery. However, PCMH evaluations have primarily focused on the performance of PCPs. AIMS: 1) To assess the extent to which PCMH measures encompass ACP-delivered care; 2) To determine trends in care delivery across different types of providers before and during PCMH implementation; and 3) To examine relationships between PCMH implementation, ACP care delivery, and resource utilization. METHODS: Study 1 was a systematic literature review of PCMH access and care coordination measures to assess their inclusion of ACP-delivered care. Study 2 analyzed five years of retrospective, in-person, clinical patient encounters by PCPs and ACPs among 764 Veterans Health Administration (VHA) primary care sites. Negative binomial regression estimated monthly rates of provider-delivered encounters among sites before and during PCMH implementation. Study 3 was a cross-sectional analysis of VHA primary care sites during two twelve-month periods, before (n=688) and during (n=684) PCMH implementation. Structural equation modeling tested whether the rate of nurse-delivered encounters mediated the effect of PCMH implementation on inpatient

hospitalization. RESULTS: Review of 42 PCMH studies found wide variability in the inclusion of ACP care in measurement approaches, and limited information about ACP impact on outcomes. Study 2 showed that ACPs delivered 29% of in-person encounters in fiscal year (FY) 2009 (pre-PCMH), and 35% in FY2013 (during PCMH implementation). Monthly rates of PCP encounters decreased, while those for some ACPs increased during PCMH implementation. Mediation analyses demonstrated a significant positive relationship between the level of PCMH implementation and the rate of nurse-delivered encounters, and a significant negative relationship between nurse-delivered encounters and the rate of hospitalizations during PCMH. CONCLUSIONS: Findings suggest that a shift in care delivery from PCPs to some ACPs occurred in VHA primary care sites after the introduction of PCMH. ACP-delivered care may be an important mechanism of how PCMH impacts outcomes and should be included in PCMH evaluations.

CHAPTER I: PRIMARY CARE DELIVERY IN THE PATIENT CENTERED MEDICAL HOME

Team-based Primary Care

Among the many facets of health care that have been targeted by reform efforts in recent years, primary care is towards the top of the list. The delivery of high quality primary care is crucial to the health of Americans. As the population continues to age and the burden of chronic illness grows, there is potential opportunity in initiatives designed to improve access to and the quality of primary care. Strengthening this initial point of entry into the health system may result in positive downstream impacts for patients through timely resolution of minor illnesses, preventive and routine care, chronic illness management, and coordination of services.

The Institute of Medicine (IOM) defines primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community" (IOM, 1994, p. 15, part 3). Five core attributes of quality primary care include: accessibility, comprehensiveness, coordination, continuity, and accountability (IOM, 1994). Primary care comprises a wide breadth of care services across the continuum of health. The delivery of these services to meet the diverse needs of patients is, therefore, ideally

suited to multidisciplinary providers, whose expertise as a coordinated team is broader than that of any individual provider.

Over the past couple decades a growing movement in primary care has encouraged a transition away from the traditional physician-centric practice model to one of team-based care delivery. Effective care teams distribute tasks among multidisciplinary providers by leveraging their unique skills and experience (Bodenheimer & Laing, 2007; Garson, 2013). Sharing responsibility for providing care is fundamental to team-based models of practice. Care activities are allocated to the most appropriate team member, maximizing provider roles and the work capacity of the team.

Although the popularity of teams has flourished in recent years, the idea of team-based delivery of primary care is not new. In fact, as early as 1978, the Institute of Medicine (IOM) promoted the use of multidisciplinary providers to deliver primary care. It suggested that because of the comprehensiveness of primary care, services ideally should be provided by a team, which may include physicians, physician assistants (PAs), nurse practitioners (NPs), nurses, social workers, technicians, and others (IOM, May 1978). In its definition of primary care, the IOM stated that the type of services provided is what constitutes primary care, and not the type of provider delivering the care (IOM, May 1978). Thus, excellent primary care can be delivered by providers from many different disciplines—a concept highly promoted today (IOM, 2011).

Team-based primary care has redesigned how clinics divide workload within teams (Ladden et al., 2013). Specifically, it requires role delineation and collaboration between primary care providers (PCPs) and associate care providers (ACPs). Herein, PCPs refer to physicians, medical residents, NPs, and PAs. PCPs assume primary

responsibility for the clinical management of the health needs of a group of patients in a primary care setting. Conversely, ACPs are core and auxiliary team members who also deliver clinical care to patients within primary care settings, but do not function as PCPs. These providers include clinical nurse specialists (CNSs), registered nurses (RNs), licensed practical nurses (LPNs), nursing assistants (NAs) or technicians, clinical pharmacists and pharmacy technicians, social workers, dietitians and nutritionists, and behavioral health providers. ACPs have taken on new roles and responsibilities under team-based care, increasingly providing services to patients independent of, or in conjunction with PCPs.

Team-based care has taken root in most major primary care initiatives, including the most popular care model—the Patient Centered Medical Home (PCMH). PCMH comprises several principles of quality primary care: patient centeredness and patient engagement in care, enhanced access to care, integrated and coordinated care, comprehensive care, and continuous performance monitoring and improvement of clinic practice. Importantly, PCMH promotes ACPs to work to the full extent of their license and training (Solimeo et al., 2013). Utilizing ACPs is advocated as an important way to address projected physician shortages and rising demands for primary care services (Bodenheimer & Smith, 2013; Garson, 2013). Allocating care tasks to ACPs can expand patients' access to care, lessen PCP workload, foster ACP practice autonomy, and improve team efficiency, all of which contribute to PCMH-related outcomes.

The drive to transform primary care has sparked a nationwide growth of PCMH and similar programs. Numerous demonstration projects have been conducted or are ongoing, evaluating the impact of PCMH on patient and provider outcomes (Bitton,

Martin, & Landon, 2010). Several federal health care organizations offer PCMH recognition and accreditation programs, including the Centers for Medicare and Medicaid Services (CMS), the Agency for Healthcare Research and Quality (AHRQ), the Health Resources and Services Administration (HRSA), The Joint Commission, the Accreditation Association of Ambulatory Health Care, and the National Committee on Quality Assurance (NCQA). These programs provide financial incentives to primary care clinics to support continued implementation and further development of PCMH. Additionally, the Patient Protection and Affordable Care Act (ACA) specifically mentions PCMH seventeen times within nine key sections, promoting the use and research of the model ("The Patient Protection and Affordable Care Act," 2010).

Statement of Problem

The popularity and expansion of PCMH has led to diverse methods by which it is defined and evaluated (Bitton et al., 2010; Hoff, Weller, & DePuccio, 2012). PCMH tools primarily measure whether specific capabilities are present in the clinic, such as an electronic medical record, or same-day appointment availability, or measure performance at a physician or PCP level. Despite the emphasis on team-based care in PCMH, few measures ascertain the delineation of team member roles or the division of clinical tasks among providers. For example, among the 178 individual items that comprise the most widely-used tool, the NCQA PCMH standards, not one explicitly requires measurement of ACP care delivery (National Committee for Quality Assurance, 2014). The limited information about ACP roles in PCMH has resulted in a gap of understanding of how team members share clinical tasks.

This study aimed to address several gaps in the literature. 1) Current PCMH measures have not previously been evaluated for their relevance and application to ACP-delivered care. The extent to which PCMH measures include and quantify ACP care activities is not known. 2) ACP clinical activity has typically not been measured systematically in primary care settings. An important goal of team-based care is to maximize ACP involvement in clinical care. Yet, the trends in ACP care delivery and the effect of PCMH on these trends is unknown. 3) The relationships between ACP-delivered care, PCMH implementation, and outcomes have not been thoroughly examined. It is not clear whether PCMH implementation has resulted in increased ACP care activities, and whether the connection between PCMH and ACP care has an impact on outcomes.

Research Aims

The specific aims of this study were: 1) To assess the extent to which PCMH access and care coordination measures encompass ACP-delivered care; 2) To determine trends in care delivery across different types of providers before and during PCMH implementation; and 3) To examine relationships between the level of PCMH implementation, ACP care delivery, and resource utilization. These aims centered on the theoretical framework of PCMH and team-based care, which infers that ACPs are important members of the care team, contributing to team efforts to improve the delivery of primary care. Therefore, ACP care activities can provide valuable information about the care delivery practices in primary care sites.

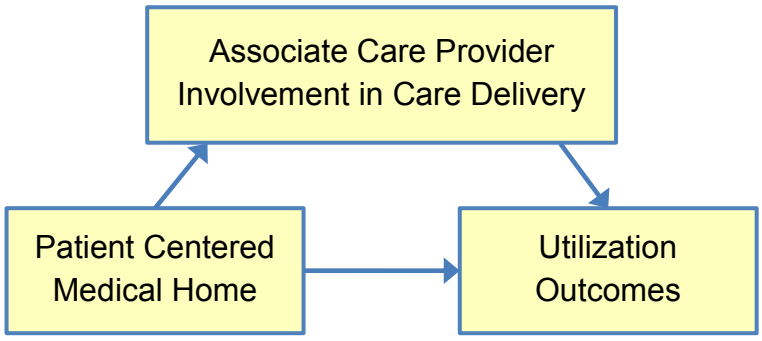
Overview of Dissertation Research

This dissertation consisted of three individual studies of ACP-delivered care in the context of PCMH. The first study was a systematic literature review of PCMH studies to ascertain the extent to which measurement approaches are inclusive of ACP care activities. The next two studies examined data from primary care clinics within the Veterans Health Administration (VHA).

In 2010, the VHA introduced a PCMH model called Patient Aligned Care Teams (PACT) nationally to all of its approximately 900 primary care clinic sites (Klein, 2011). This research capitalizes on the PCMH experience of VHA and the availability of primary care clinical encounter data from the largest integrated health system in the U.S. The work was conducted at the Veterans Affairs Ann Arbor Healthcare System (VAAAHS) Center for Clinical Management Research (CCMR), which was one of five national VHA PACT Demonstration Laboratories specifically created to evaluate PACT implementation. Thus, this study benefited from the experiences of PACT researchers at CCMR and from prior, informative evaluation work. The evolution of team-based care during VHA's PACT implementation, along with extensive health system data provided an ideal environment in which to study the relationships between ACP care, PCMH, and outcomes. This research was reviewed and approved by the Institutional Review Boards of VAAAHS and the University of Michigan.

As designed, the implementation of PCMH should result in increased ACP care activities. And, both PCMH and ACP care have been shown to be associated with utilization outcomes (Coleman & Phillips, 2010; Foltz et al., 2014; Gilfillan et al., 2010; Kind et al., 2012; Martinez-Gonzalez et al., 2014; Raskas et al., 2012; Reid et al., 2009;

Roby et al., 2010; Sommers, Marton, Barbaccia, & Randolph, 2000; van Loenen, van den Berg, Westert, & Faber, 2014). Thus, this study posits that ACP involvement in the delivery of clinical care is a mediator in the pathway of PCMH effect on outcomes (see figure below). This theoretical framework suggests that the extent to which ACPs are involved in providing patient encounters is measureable and an important mechanism of how PCMH improves outcomes.



The following are descriptions of the content of each chapter.

Chapter II: Measurement of ACP Care Delivery

CHAPTER II reviewed the literature to examine the extent to which current PCMH measures reflect the care provided by ACPs, as an important indicator of team-based care. Previous reviews of PCMH research have examined the effect of PCMH implementation on patient outcomes, quality of care, and financial costs (Alexander & Bae, 2012; Arend, Tsang-Quinn, Levine, & Thomas, 2012; Hoff et al., 2012; Jackson et al., 2013; Nielsen, Langner, Zema, Hacker, & Grundy, 2012; Peikes, Zutshi, Genevro, Parchman, & Meyers, 2012; Peikes, Zutshi, Genevro, Smith, et al., 2012). But none have focused on whether measurement approaches sufficiently include ACP-delivered care. Ascertaining the contribution of ACP roles to key components of PCMH is important for PCMH evaluation, workforce planning and the

development of effective teams in primary care. Therefore, this literature review assessed PCMH measures with respect to their inclusion of ACP-delivered care, addressing Aim 1 as stated above. Specifically, two types of measures frequently found in PCMH evaluations and likely sensitive to ACP care activities were selected: access and care coordination. Three on-line research databases were searched for studies of PCMH programs in the U.S. that reported measurement of either access or care coordination. Studies that focused exclusively on pediatric or non-primary care practice, such as specialty care, were excluded. Among 643 unique articles identified, 42 met inclusion criteria. These articles were summarized and organized by content themes apparent from the measures, and a detailed description of the 42 studies is included in the APPENDIX.

Chapter III: Trends in ACP Care Delivery

CHAPTER III analyzed the trends in ACP-delivered clinical encounters in VHA during a five-year study period. Although studies have previously quantified clinical patient encounters with PCPs (Huang, Yano, Lee, Chang, & Rubenstein, 2004; Morgan, Abbott, McNeil, & Fisher, 2012; Way, Jones, Baskerville, & Busing, 2001), little is known about the care provided by ACPs, particularly non-nursing ACP roles. Thus, this chapter addressed Aim 2 to describe how documented primary care encounters are distributed across different types of providers among primary care sites, and to determine whether this distribution has changed since VHA's introduction of PACT in 2010.

This study (Study 2) analyzed documented clinical patient encounter data from 764 national VHA primary care clinic sites: 155 Veterans Affairs Medical Centers (VAMCs), and 609 Community Based Outpatient Clinics (CBOCs). The monthly rates of in-person encounters that occurred during a five year period (FY2009-FY2013) for

twelve different types of providers were calculated for patients assigned to these clinics. The study included between 4.3 and 5.3 million patients each year, and over 11 million in-person encounters each year. Multivariate regression analyses were conducted to obtain adjusted, predicted monthly encounter rates pre- and during PACT implementation.

This measurement of ACP-delivered care is an initial step towards better understanding the entire scope of primary care services provided by various roles. Given the heightened interest and need for improving patients' access to care, it is critical to develop feasible ways in which to systematically monitor ACP-delivered primary care services as an important indicator of access. Furthermore, health reform efforts are redesigning reimbursement mechanisms, which will increasingly require an accounting of specific care activities that are frequently performed by ACPs, such as care management.

Chapter IV: Impact of ACP Care Delivery on Utilization

CHAPTER IV examined the relationships between ACP-delivered encounters, PCMH components, and health resource utilization. Linkages among these concepts have been previously reported, although not all three simultaneously. This chapter addressed Aim 3 to determine whether the involvement of ACPs, specifically nurses, in providing clinical encounters mediates the impact of the level of PCMH implementation on utilization outcomes.

Study 3 included cross-sectional data from two 12-month time periods: April 2009-March 2010 (pre-PACT), and April 2011-March 2012 (interim PACT). The sample consisted of 688 VHA primary care clinics with 3.7 million patients in the pre-PACT

period, and 684 of the clinics with 4.1 million patients in the interim PACT period. The level of PCMH implementation was measured by a PCMH survey administered to the clinics in each time period. Structural equation modeling was used to test for a mediator effect. The 12-month rate of in-person primary care encounters delivered by nurses was modeled as a potential mediator of the effect of the level of PCMH implementation on the 12-month rate of inpatient hospitalization.

As PCMH programs continue to grow nationally, it is increasingly important to demonstrate their value, which includes their effect on team-based care and ACP care delivery. Additionally, the promotion of value-based incentives and reimbursement emphasizes the need to be able to associate care activities with better outcomes. Thus, it is critical to include assessments of ACP-delivered care in PCMH evaluations.

Chapter V: Conclusions and Implications for Research and Practice

CHAPTER V summarizes the findings from this research. Key messages arising from the review of literature pertaining to ACP-delivered care, the distribution and trends of ACP encounters, and the relationships between ACP care delivery, PCMH implementation and utilization are discussed. Implications for practice and research are identified, and recommendations for future studies are outlined.

CHAPTER II: MEASUREMENT OF CARE PROVIDED BY ASSOCIATE CARE PROVIDERS: A LITERATURE REVIEW

Introduction

Primary care delivery systems are transitioning to team-based practice models, including the increasingly popular Patient-Centered Medical Home (PCMH). Team-based care involves a partnership between primary care providers (PCPs)—e.g., physicians, nurse practitioners (NPs), and physician assistants (PAs)—and other team members collectively referred to as associate care providers (ACPs). ACPs provide care that is supplementary to, or a substitute for care by PCPs. In primary care settings, ACPs generally include registered nurses (RNs), licensed practical nurses (LPNs), nursing and medical assistants (NAs, MAs), and clerks, but may also include clinical pharmacists, social workers, and registered dietitians. By leveraging the skills and expertise of all members of the care team, PCMH is touted as a more efficient and cost-effective approach to care delivery than the traditional physician-centric model (Bodenheimer, Ghorob, Willard-Grace, & Grumbach, 2014; Grumbach & Bodenheimer, 2004; Wagner, 2000).

Despite increasing adoption of team-based models, supported in part by the movement towards value-based reimbursement, most performance measures are linked to physician providers. Few PCMH evaluations explicitly assess team-based care (Burton, Devers, & Berenson, 2011). Previous reviews of PCMH studies have focused

on the effectiveness of PCMH on quality, cost, and patient outcomes (Alexander & Bae, 2012; Hoff et al., 2012; Jackson et al., 2013; Nielsen et al., 2012). None have evaluated PCMH measures specifically to assess their level of inclusion of ACP care.

This systematic review examines the literature on PCMH measures to determine the extent to which PCMH measures reflect care provided by ACPs. We selected two types of measures that are frequently included in PCMH evaluations and likely sensitive to ACP care activities: access to care and care coordination. The two questions that guided this review were: 1) To what extent do PCMH measures of access and care coordination encompass ACP-delivered care? And, 2) Have studies including ACP-delivered care linked that care, via access and care coordination measures, to PCMH outcomes?

Methods

Data Sources and Searches

In August 2014, a search was conducted using the research databases of Ovid MEDLINE and Ovid MEDLINE In-Process & Other Non-Indexed Citations, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Health and Medicine database of the ProQuest Research Library using the search terms: ("medical home*" or "PCMH" or "health home*") and ("access" or ("care coordinat*" or "coordinat* care" or "care manag*" or "care transition*")). We specified variations of 'care coordination' since this term is often used interchangeably with 'care management' and 'care transitions'. The search was limited to articles from scholarly journals published in English.

Study Selection

We included articles published between January 2007 and August 2014. This timeframe was selected to align with publication of the Joint Principles of PCMH (American Academy of Family Physicians, 2008), which was followed by the formalization of many PCMH programs. We categorized measures as access measures when the researchers reported them as access-related. Because of multiple variations in care coordination definitions, we included measures explicitly labeled as care coordination as well as those that used similar terms, such as collaboration, teamwork, continuity of care, and disease/case/care management (McDonald et al., 2007). Although most studies reported quantitative measures, qualitative studies were included when they used a PCMH-relevant framework for analysis.

We excluded articles that reported access or care coordination outcomes, but did not specify a measure or operational definition related to access or care coordination. Studies were also excluded when the objectives focused only on care by physicians. International studies were excluded because of likely differences in health policies and potential use of ACPs. Studies that primarily pertained to pediatric practice or non-primary care environments, such as the emergency department (ED) or specialty care, were excluded due to expected differences in care needs.

Data Extraction

We identified 513 records from Ovid MEDLINE, 272 from CINAHL, and 310 from ProQuest, yielding 643 unique articles that matched our initial search criteria (FIGURE 1). All relevant information, including abstracts, was downloaded into a spreadsheet for further analyses. In the first stage, titles were screened to exclude records that were

obviously not relevant to the study (n=259). During stage two, abstracts were screened, and those that were clearly not related to PCMH, constituted a position or opinion statement, or contained a description of PCMH elements or policy rather than original research, as well as those with previously mentioned exclusion criteria were dropped (n=264). In the final stage, 78 additional articles were eliminated following full text review; resulting in 42 articles included in the final review.

Analysis

Definitions and descriptions of the access and/or care coordination measures were summarized and organized according to content themes. We included observations from qualitative studies when the authors purposively collected information about access or care coordination, or when access or care coordination concepts were elicited and deemed an important focus of the research. Measures were stratified by whether the data were collected from a practice or clinic perspective, a provider perspective, or a patient perspective. Finally, we recorded whether the measures were specifically linked to patient or provider outcomes. A complete detailed description of the 42 articles is included in the APPENDIX.

Results

Study characteristics are reported in TABLE 1. Among the 42 studies, 40 reported access measures, 40 reported care coordination measures, and 38 reported on both access and care coordination. The most common study setting was primary care practices or multiple types of primary care sites (n=13). Studies frequently developed or used a unique tool for measuring access or care coordination (n=22). Over half (n=23) of the studies used a cross-sectional design (TABLE 2). Nineteen studies assessed

access and/or care coordination from the patient perspective, 17 from a practice perspective, and 13 from the provider perspective. With the exception of five qualitative studies, PCMH studies tended to be fairly large and quantitative in their measurement approach.

Access to Care

Consistent with reported strategies to improve patient access to primary care by expanding the responsibilities of nurses and other ACPs (Bodenheimer & Smith, 2013; Ghorob & Bodenheimer, 2012b; Green, Savin, & Lu, 2013; Institute of Medicine, 2011), we grouped access to care measures into three themes: appointments, communication, and continuity with a provider (TABLE 3).

Appointments

Access to same-day or urgent care appointments usually pertained only to appointments with a PCP (Alidina, Schneider, Singer, & Rosenthal, 2014; Birnberg et al., 2011; Christensen et al., 2013; Coleman & Phillips, 2010; Day et al., 2013; Hays et al., 2014; Lewis et al., 2012; Nocon et al., 2012; Rosland, Nelson, et al., 2013; Yoon et al., 2013), or was non-specific regarding the team member providing the appointment (Goldberg & Kuzel, 2009; Hochman et al., 2013; Jaen et al., 2010; Khanna, Shaya, Chirikov, Steffen, & Sharp, 2014; Nelson et al., 2014; Savage, Lauby, & Burkard, 2013; Schmidt, Rittenhouse, Wu, & Wiley, 2013), making it unclear whether appointments with other provider types were counted in the measure. No study explicitly defined same-day or urgent access to include visits with an ACP.

Time spent waiting for appointments generally referred to waiting to see a PCP. Patients were asked whether they saw their PCP within 15 minutes of their scheduled appointment (Carvajal, Blank, Lechuga, Schechter, & McKee, 2014; Hays et al., 2014;

Kern, Dhopeshwarkar, Edwards, & Kaushal, 2013), or how long they waited for an appointment to see a PCP (Christensen et al., 2013; Ferrante, Balasubramanian, Hudson, & Crabtree, 2010; Kennedy et al., 2013; Nelson et al., 2014). Berry et al. (2013) measured the number of days a patient with non-urgent needs waited for an appointment with a clinician. In three studies, patients identified wait time as a barrier to or negative experience of access (Mead, Andres, & Regenstein, 2014; Takane & Hunt, 2012; Van Berckelaer et al., 2012).

Access from the patient perspective included appointments as soon as needed, which was measured by 12 of the studies. Although one study defined this as the ability to see a PCP when needed (Christensen et al., 2013), most used broadly worded survey questions, such as obtaining access at the appropriate time (Bruder, Mogro-Wilson, & Kerins, 2010), getting appointments for routine care (Hays et al., 2014; Hochman et al., 2013), ease of getting appointments when needed or desired (Carvajal et al., 2014; Heyworth et al., 2014; Jaen et al., 2010; Kennedy et al., 2013; Kern et al., 2013), or the availability of appointments (Nelson et al., 2014).

Communication

Communication measures focused on a patient's ability to access clinical advice by phone during or after office hours, communicate electronically with the practice, and access translation services. Although some studies were more inclusive of ACPs, particularly nurses providing telephone access (Coleman & Phillips, 2010), other communication measures were not consistent in the type of providers included. For example, Berry et al. (2013) assessed whether a *clinician* was able to return patient calls received during office hours on the same day, respond to those who call outside of office hours, and communicate with patients via e-mail; yet, then asked whether the

practice had arrangements for patients to see a doctor *or nurse* for non-emergent problems on evenings or weekends (Berry et al., 2013). Other communication measures were limited to specific providers. Rittenhouse et al. (2011) defined e-mail access as whether the majority of physicians communicate with patients via e-mail.

Continuity with provider

Continuity of care measures generally fell within the care coordination domain (see Care Coordination), however, six articles specifically reported continuity as an access measure, all of which referred to continuity with a PCP (Birnberg et al., 2011; Coleman & Phillips, 2010; Day et al., 2013; Lewis et al., 2012; Nocon et al., 2012; Yoon et al., 2013).

Care Coordination

We grouped care coordination measures into the following categories: care management, communication and coordination, continuity of care, team-based care, and follow-up (TABLE 3).

Care management

Several studies measured care management from a practice perspective, including chronic disease screening, patient education, and medication management, and typically assessed whether the practice, not a particular provider, provided the service (Alidina et al., 2014; Day et al., 2013; Goldberg & Kuzel, 2009; Hearld, Weech-Maldonado, & Asagbra, 2013; Jaen et al., 2010; Yoon et al., 2013). One study did stratify care management tasks as delivered by MD, ancillary staff, or health plan or disease management program (Coleman & Phillips, 2010), while five others assessed whether the practice had specially-trained staff, nurses, or health educators to carry out specific care management practices (Berry et al., 2013; Ferrante et al., 2010; Friedberg,

Safran, Coltin, Dresser, & Schneider, 2009; Rittenhouse et al., 2011; Rittenhouse, Schmidt, Wu, & Wiley, 2012).

Similarly, among studies that took a provider perspective, some phrased survey questions in general terms, such as “our clinic” or “my practice/team,” or simply referred to the practice when ascertaining care management (Khanna et al., 2014; Lewis et al., 2012; Ullrich, MacKinney, & Mueller, 2013). Conversely, Anderson et al. (2012) measured nursing time spent on care coordination activities in a Federally Qualified Health Center undergoing PCMH transformation. Others measured the presence of care managers who assumed several functions, such as patient education, health coaching, and self-management support (Taliani, Bricker, Adelman, Cronholm, & Gabbay, 2013), or where PCPs relied on care managers for certain tasks, such as preventive services (Nelson et al., 2014).

Studies that took a patient perspective varied in their inclusion of ACPs. Some simply gathered information about whether the clinic or doctor’s office provided self-management support and preventive services (Lebrun-Harris et al., 2013; Maeng, Davis, Tomcavage, Graf, & Procopio, 2013), patient education (Kennedy et al., 2013), goal setting and counseling (Carvajal et al., 2014), or disease management (Kern et al., 2013). Some studies used national patient survey tools, which tended to focus on PCPs. For example, the Consumer Assessment of Healthcare Providers and Systems (CAHPS) PCMH survey asks patients whether a provider talked to them about health goals, barriers to self-care, and medication (Hays et al., 2014), while the Press Ganey survey asks patients whether a clinician educated them about their condition and medication (Heyworth et al., 2014). Stevens et al. (2014) asked patients whether a

physician had given them a plan to manage care at home, discussed specific care topics with them, such as disease self-management, and whether they had met with a dietician.

Communication and coordination

Studies using the CAHPS survey measured provider communication by asking patients whether the provider listened to their needs, answered their questions, and explained things in an understandable manner (Carvajal et al., 2014; Hays et al., 2014; Kern et al., 2013). The assessment of care by ACPs was often framed in a customer service tone, asking whether clerks were helpful, courteous, or friendly (Carvajal et al., 2014; Hays et al., 2014; Kern et al., 2013), the friendliness of staff (Kennedy et al., 2013), friendliness of nurse or assistant (Heyworth et al., 2014), or helpfulness of nurse and receptionist (Maeng et al., 2013).

From a practice or provider perspective, studies assessed communication and coordination by patients' receipt of coordinated care (Khanna et al., 2014), the presence of coordination among staff (Lewis et al., 2012), or the coordination of visits with multiple clinicians (Alidina et al., 2014). Inclusive of ACPs, Coleman et al. (2010) assessed whether non-physicians shared responsibility for coordinating care with others. Conversely, another study defined this measure as clinicians communicating with other clinicians outside of the practice, and clinicians coordinating care with specialists (Berry et al., 2013). We found one instance where researchers removed care coordination questions pertaining to communication with outside specialists from a survey and calculation of a PCMH score because they felt that these questions only pertained to physicians and not to staff (Lewis et al., 2012).

Continuity of care

Continuity of care measures were reported under domains of personal physician (Berry et al., 2013; Ferrante et al., 2010; Goldberg & Kuzel, 2009), care team (Day et al., 2013), continuity of care (Moore, Hamilton, Pierre-Louis, & Jennings, 2013; Nelson et al., 2014; Rosland, Nelson, et al., 2013), and care coordination (Hochman et al., 2013; Schmidt et al., 2013). With one exception, these measures referred to continuity with a PCP (Berry et al., 2013; Day et al., 2013; Ferrante et al., 2010; Goldberg & Kuzel, 2009; Moore et al., 2013; Nelson et al., 2014; Rosland, Nelson, et al., 2013). One study measured continuity with a medical assistant throughout the patient visit as a care team measure (Day et al., 2013). None of the studies measured continuity with a nurse or the care team.

Team-based care

A small number of studies measured aspects of team-based care coordination among PCPs and ACPs, and determined whether the practice team relied on the involvement of ACPs in care delivery, such as the use of non-physician staff to manage patient care (Alidina et al., 2014), non-physicians sharing management of care (Coleman & Phillips, 2010), the use of nurse care managers to manage severely or chronically ill patients (Rittenhouse et al., 2011; Rittenhouse et al., 2012), the use of patient educators for chronic illness care and detection (Rittenhouse et al., 2012), the practice's encouragement of nurse input in work processes (Ferrante et al., 2010), or medical assistant engagement in a patient visit (Day et al., 2013). Other measures simply ascertained the presence of non-physician, or ancillary staff in the practice (Ferrante et al., 2010; Goldberg & Kuzel, 2009). Staff huddles or team meetings were

also reported as team-based care (Day et al., 2013; Martinez-Gutierrez et al., 2013; Nelson et al., 2014; Taliani et al., 2013).

Follow-up

Coordinating follow-up activity for patients was frequently assessed in the studies, and included practice-based measures of reminders for patients and clinicians of services needed (Alidina et al., 2014), patient reminders about preventive or follow-up care (Birnberg et al., 2011; Friedberg et al., 2009), provider alerts about needed services for patients (Birnberg et al., 2011), systems for contacting patients who are overdue for preventive care (Friedberg et al., 2009), notification of patient hospitalization (Hearld et al., 2013), and processes for tracking care coordination and follow-up (Hearld et al., 2013). Only a few studies specified the provider performing the function. Berry et al. (2013) described post-discharge follow-up as delivered by the clinician, while Coleman et al. (2010) assessed whether several follow-up care management activities were performed by a MD, ancillary staff, or health plan.

Among studies that surveyed providers, there were similar measures that determined the presence of systems for providing reminders (Lewis et al., 2012), tracking tests and referrals (Ferrante et al., 2010; Ullrich et al., 2013), and communicating test results to patients (Ferrante et al., 2010). One study took a team focus and measured whether the team reviews patients' disease prevention needs, schedules post-discharge follow-up, and referral of complex patients to a care management team (Khanna et al., 2014). Several studies focused on a patient perspective, and asked patients about the ease of completing tests and adequacy of test results communication (Hochman et al., 2013), follow-up for test results (Hays et al., 2014; Kennedy et al., 2013; Kern et al., 2013; Maeng et al., 2013), receipt of follow-

up and tracking of care (Carvajal et al., 2014; Jaen et al., 2010), or follow-up on visits to other health professionals (Jaen et al., 2010).

ACP Effect on Outcomes

Less than half of the studies (n=18) reported any evaluation of outcomes in their assessments of access and care coordination; even fewer (n=8) illuminated aspects of ACP-delivered care in relation to outcomes (Christensen et al., 2013; Day et al., 2013; Ferrante et al., 2010; Heyworth et al., 2014; Khanna et al., 2014; Lebrun-Harris et al., 2013; Lewis et al., 2012; Stevens et al., 2014). Christensen et al. (2013) reported that patients in PCMH practices had a higher level of customer service satisfaction with office staff, as compared to those in comparison practices, and that access measures were significantly related to patient satisfaction with office staff. Ferrante et al. (2010) found no significant relationship between the use of nurses or health educators for preventive counseling or the solicitation of nursing input and patients' receipt of preventive services. Heyworth et al. (2014) found that team-based care was not related to patient satisfaction. Khanna et al. (2014) measured staff perceptions of change in care processes 18 months after PCMH implementation, and found that medical assistants perceived more change than physicians. Lewis et al. (Lewis et al., 2012) identified a significant association between both access and care coordination measures and increased staff morale and job satisfaction. Stevens et al. (2014) found that patients with diabetes in practices scoring higher on several PCMH domains, including coordination, were more likely to have visited a dietitian, compared to those in lower-scoring practices.

Although the studies listed above include aspects of ACP-related care, most reported the ACP-related measure as the outcome (e.g., perception of change in clinic processes, staff morale and job satisfaction, visit with dietitian). Only two studies demonstrated links between ACP-delivered care and PCMH-related outcomes (Day et al., 2013; Lebrun-Harris et al., 2013). Day et al. (2013) found positive correlations between quality of care measures and both MA engagement and team huddles; patient satisfaction with the clinician was positively correlated with MA continuity (Day et al., 2013). Lebrun-Harris et al. (2013) found that both access and communication with clinicians and support staff had a significant positive association with patient perception of quality.

Discussion

We identified several issues related to access and care coordination measures as they pertain to ACP-delivered care. First, many measures were specific to physicians or other PCPs. Enhanced access, a key component of PCMH, was frequently measured by the availability of access to a PCP. No study measured patient visits to an ACP as an indicator of access, although some care coordination measures did include ACP activities. The preference for PCPs in access measures contradicts the team-based approach that underlies PCMH concepts.

Some measures were so broad as to provide little information on ACP contribution. The NCQA PCMH tool, frequently used in PCMH evaluations, includes phrases such as “the practice provides…” and “the practice does…” (National Committee for Quality Assurance, 2014). This broad terminology is likely intentional so as not to be prescriptive, recognizing that the staffing composition, care processes, and

implementation strategies vary considerably across practices. Thus, such measures are useful in assessing the degree of PCMH transformation and the associated impact on outcomes at a *practice* level, but do not provide information on how or to what extent care is distributed among team members within practices, or how various combinations of team-based care affect outcomes. Echoing these issues, Alexander and Bae (2012) suggested that the emphasis by many researchers to develop composite scores limits the ability to recognize how the individual components, such as team-based care, work in conjunction with each other.

Finally, although there were few links between ACP care and outcomes, we found studies anecdotally reported positive effects of ACPs on access and care coordination. For example, Coleman et al. (2010) created a 'teamness' index that was based on whether non-physicians shared responsibility with ACPs for managing care in four specific care coordination areas. Practices that scored high in 'teamness' were more likely to report well-functioning processes to support access and communication, and connect chronically ill patients to self-management programs, as compared to low-scoring practices (Coleman & Phillips, 2010). Likewise, focus groups with low-income patients with heart disease conducted by Mead et al. (2014) identified non-physicians as having a key role in care management activities. Finally, staff interviews by Martinez-Gutierrez et al. (2013) at four clinic sites found that most participants reported having designated non-physician staff to do preventive activities, and that this was viewed as an effective facilitator of cancer screening. Additionally, the routine morning huddles, whereby the care team would meet to review patient needs and coordinate care

activities, contributed to an efficient distribution of workload (Martinez-Gutierrez et al., 2013).

Limitations

Our literature search included articles published in 2007 or later, potentially eliminating some studies. However, given the lack of clear definitions of PCMH prior to 2007, it is unlikely that an earlier time frame would have produced studies with a more enriched measurement of ACP-delivered care. Additionally, some studies may assess components of PCMH without actually defining them as elements of PCMH; these studies would have been excluded from our review. In addition, it is possible that other reviewers of this literature may have categorized findings differently; our categorization was based on reported use of measures within the study.

Conclusions

Our findings bring to light several policy implications for consideration in the development, collection, and application of ACP- and team-sensitive measurement approaches. Foremost is the need to clearly define what should be measured, and evaluate whether measures have kept pace with the continuing evolution of the PCMH model. Surveys that simply measure the presence of ACPs in the care team do not sufficiently speak to the functions they perform. Similarly, surveys that ask patients about their PCP's assistance in setting health goals, coordinating care, communicating and spending enough time with them, yet only ask about the courtesy and friendliness of ACPs, do not reflect the team practice that underlies PCMH.

In an effort to acknowledge the importance of teams, NCQA recently added a team-based care standard to its PCMH 2014 Standards. However, none of the items

mentions teams, or provides explicit links between items and those who provide the service. Rather, the four items are: assisting patients to select a personal clinician, monitoring the percentage of patient visits with the selected clinician, having a process to orient new patients to the practice, and collaborating with the patient during the transition from pediatric to adult care (National Committee for Quality Assurance, 2014).

In addition, consideration must be given to how data for measures are collected. Because ACP encounters have historically fallen under non-reimbursable activities, they are often not documented consistently or at all, which makes formal measurement of ACP activity challenging. Furthermore, survey-driven practice-based PCMH assessments have tended to primarily involve PCP respondents, rather than other staff. We found one study that included a rationale for this in that the researchers felt physicians were in the “best position to provide information on practice characteristics and patient services” (Goldberg & Kuzel, 2009, p. 302). Conversely, Friedberg et al. (2009) reported that the physician respondents were not knowledgeable about some survey questions, such as the staff composition in the practice, which resulted in the necessity of revising or dropping questions from the survey. It is reasonable to expect that not any one provider role would be most familiar with all aspects of a practice, and that multiple provider perspectives may be advantageous for a more complete picture.

Lastly, the manner in which measures are used and reported has implications for inferences about the effectiveness of team-based care. Measures in PCMH evaluations are typically calculated and reported at a PCP or practice level, not by team, likely because patient panels are assigned to PCPs rather than teams. Therefore, attribution of outcomes is at the PCP level or when aggregated, at a practice level. We found this

to be true even despite the presence of measures that were inclusive of ACPs. For example, although Day et al. (2013) assessed the engagement and continuity of MAs in patient visits, these indicators were reported at a clinician level. Maeng et al. (2013) phrased survey questions to be inclusive of the team (e.g., "how often did your primary care provider and his/her team…"), yet these items were grouped under PCP performance, as were questions about the helpfulness of the nurse and receptionist. Restructuring the architecture of PCMH-related performance measures is a necessary next step. Moreover, the combination of measures across multiple domains as composite PCMH scores (Nelson et al., 2014) and the lack of detailed information about the contribution of ACPs limit inferences about an ACP-related effect on outcomes (Jaen et al., 2010; Yoon et al., 2013).

Recommendations

Based on the findings and implications of this study, we provide three key recommendations for further development and use of PCMH measures. 1) PCMH measures should align with the goals and desirable outcomes of PCMH implementation. For example, if the ultimate goal of improving patient access to care is that patients receive timely, quality care, with resolution of urgent care needs, then patient visits with ACPs should be counted as access events. Thus, the focus of measurement should be on whether patients' needs are met. Determination of the type of provider who delivered the care should be used to further stratify the measure of access, rather than as inclusion criteria for the measure.

2) Current care coordination measures in national PCMH tools should be re-evaluated in terms of their structure and wording. Given that care coordination

encompasses a wide range of tasks, there is likely much overlap between PCP and ACP responsibilities. Therefore, similar to access measures, measurement of care coordination tasks should not be limited to specific types of providers. For example, the CAHPS PCMH survey is one of the most popular tools nationally and was used by six studies in this review (Carvajal et al., 2014; Christensen et al., 2013; Hays et al., 2014; Hochman et al., 2013; Kern et al., 2013; Nelson et al., 2014). Survey items related to care coordination include questions that ask patients whether their PCP performed tasks, such as discussed health goals and medication, and explained things in understandable manner. However, patients are only asked about the friendliness and courteousness of clerks, and none of the questions pertain to team-oriented practice or specific ACP activities. This contrast in the descriptions of provider-delivered care sends an explicit message to patients about the roles different providers have in a PCMH setting, and perpetuates an image of physician-centric practice—one that is in conflict with a team-based care model.

3) The emphasis on teams in PCMH programs warrants further consideration of how performance-based measures are collected and reported. The collection of survey data from clinics and clinic personnel should obtain the perspectives of all types of providers on the care team. Furthermore, measures that speak to the performance of clinics or team should be designed to permit analysis and reporting at a team level. Although PCP performance measures can provide valuable information about the quality of care in a clinic, PCMH measures should not be limited to PCP-only assessments of care.

Summary

In summary, we found a lack of specificity of provider roles in access and care coordination measures commonly used in PCMH evaluations, and little empirical evidence linking ACP-delivered care to PCMH outcomes. Without a better understanding of the contributions of all team members, it is difficult to draw conclusions about the mechanism of PCMH or how ACP-delivered care plays a role in PCMH-related outcomes. Given increasing use of PCMH measures in performance- and value-based reimbursement strategies, there is vital need to reframe these measures within a team context. This will require further recognition and assessment of ACP roles in primary care delivery.

Table 1: Characteristics of studies included in the PCMH literature review.

Study characteristics	N (Total n=42)
Focus area included in study	
Access to care	40
Care coordination	40
Both access to care and care coordination	38
Setting / organization	
Federal healthcare system (military, VA)	6
Safety-net clinics / Federally Qualified Health Centers (FQHCs)	9
Independent, or multiple types of primary care sites	13
University / academic-based health care organization	3
Payer-based	6
No particular site (individual providers or patients)	5
Region	
Single site	6
Multi-site, single state	23
Multi-site, multi-state	13
Measurement approach for access and care coordination indicators	
Original or unique tool	22
Agency for Healthcare Research and Quality Consumer Assessment of Healthcare Providers and Systems (AHRQ CAHPS)	6
Ambulatory Care Experiences Survey (ACES)	2
American College of Physicians Medical Home Builder (ACP MHB)	3
Components of Primary Care Index (CPCI)	1
Health Center Patient Survey	1
Health Tracking Physician Survey (HTPS)	1
National Committee for Quality Assurance Physician Practice Connections Patient Centered Medical Home (NCQA PPC-PCMH)	6
National Demonstration Project (NDP)	1
Patient Assessment of Chronic Illness Care (PACIC)	1
Perceived Access to Health Services (PAHS)	1
Press Ganey	1
Primary Care Assessment Survey (PCAS)	2
Primary Care Assessment Tool (PCAT)	1
Safety Net Medical Home Scale (SNMHS)	2
VHA Patient Aligned Care Team Compass	1

Table 2: Number of studies (number of subjects) by study design and perspective of access and care coordination measures among the 42 studies in the literature review.

Study design	Total uniques*	Perspective		
		Practices / clinics	Providers	Patients
Total	**42**	**17 (7,063)**	**13 (8,449)**	**19 (95,507)**
Randomized trial	2	2 (61)		1 (1,827)
Cross-sectional	19	9 (4,318)	5 (2,590)	7 (11,823)
Cross-sectional, comparison groups	4		1 (180)	4 (4,012)
Correlational	2	1 (10)		1 (200)
Observational	3	2 (963)	2 (5,414)	1 (75,101)
Cohort comparison, pre-post	1			1 (4,090)
Longitudinal	2	2 (1,681)		
Mixed methods	4	1 (30)	4 (247)	
Qualitative	5		1 (18)	4 (454)

* Total will not necessarily equal the sum of the three categories, due to some studies using multiple perspectives and thus, included in more than one perspective category.

Table 3: Access and care coordination measures, by studies and perspective (Total n=42).

Measure	N	Perspective: Practices / Clinics	Perspective: Providers / Staff	Perspective: Patients
Access to care				
Appointments				
Open access; advanced access scheduling	5	Berry (2013), Hearld (2013), Yoon (2013)	Aseltine (2010), Driscoll (2013)	
Same-day or urgent appointments	18	Alidina (2014), Birnberg (2011), Coleman (2010), Day (2013), Goldberg (2009), Hearld (2013), Jaen (2010), Nelson (2014), Nocon (2012), Rosland (2013), Yoon (2013)	Khanna (2014), Lewis (2012), Savage (2013)	Christensen (2013), Hays (2014), Hochman (2013), Schmidt (2013)
Getting appointment as soon as needed	12		Savage (2013)	Bruder (2010), Carvajal (2014), Christensen (2013), Hays (2014), Heyworth (2014), Hochman (2013), Jaen (2010), Kennedy (2013), Kern (2013), Maeng (2013), Nelson (2014)
Group visits; shared medical appointments	9	Goldberg (2009), Jaen (2010), Nelson (2014), Rittenhouse (2011), Rosland (2013), Yoon (2013)	Aseltine (2010)	Heyworth (2014), Van Berckelaer (2012)
Open before/after usual hours and/or on weekends	6	Friedberg (2009), Goldberg (2009), Hearld (2013), Rittenhouse (2012)		Bruder (2010), Heyworth (2014)

Measure	N	Perspective		
		Practices / Clinics	Providers / Staff	Patients
Wait time for appointments or other services	13	Berry (2013)		Bruder (2010), Carvajal (2014), Christensen (2013), Ferrante (2010), Hays (2014), Kennedy (2013), Kern (2013), Mead (2014), Moore (2013), Nelson (2014), Takane (2012), Van Berckelaer (2012)
Provider/staff available time with patients	6		Anderson (2012), Lewis (2012)	Hays (2014) Heyworth (2014), Kern (2013), Moore (2013)
Communication				
Advice or assistance via phone during office hours; response to phone messages	21	Alidina (2014), Berry (2013), Birnberg (2011), Coleman (2010), Day (2013), Goldberg (2009), Nelson (2014), Rittenhouse (2012), Rosland (2013), Yoon (2013)		Carvajal (2014), Christensen (2013), Ferrante (2010), Hays (2014), Heyworth (2014), Hochman (2013), Jaen (2010), Maeng (2013), Mead (2014), Nelson (2014), Schmidt (2013), Van Berckelaer (2012)
Advice or assistance after office hours	12	Berry (2013), Goldberg (2009), Hearld (2013), Jaen (2010), Nocon (2012), Rittenhouse (2012)		Carvajal (2014), Hays (2014), Hochman (2013), Jaen (2010), Maeng (2013), Nelson (2014), Schmidt (2013)

Measure	N	Perspective		
		Practices / Clinics	Providers / Staff	Patients
Electronic communication; email	12	Alidina (2014), Berry (2013), Ferrante (2010), Goldberg (2009), Hearld (2013), Jaen (2010), Nelson (2014), Rittenhouse (2012), Rittenhouse (2011), Rosland (2013), Yoon (2013)		Mead (2014)
Interpreters; translation services	7	Berry (2013), Friedberg (2009), Goldberg (2009), Hearld (2013), Rittenhouse (2012)	Lewis (2012), Martinez-Gutierrez (2013)	
On-line patient portal for health information; interactive website	2	Day (2013), Rittenhouse (2012)		
Continuity				
Continuity with provider	6	Birnberg (2011), Coleman (2010), Day (2013), Nocon (2012), Yoon (2013)	Lewis (2012)	
Care coordination				
Care management				
Pre-visit preparation	3	Coleman (2010), Day (2013), Yoon (2013)		
Wellness promotion; disease prevention and screening; population health management	7	Ferrante (2010), Friedberg (2009), Jaen (2010)	Khanna (2014)	Kennedy (2013), Lebrun-Harris (2013), Maeng (2013)

Measure	N	Perspective		
		Practices / Clinics	Providers / Staff	Patients
Chronic disease registries; identification of high-risk patients and their needs	7	Day (2013), Goldberg (2009), Hearld (2013), Rittenhouse (2012), Rittenhouse (2011)	Lewis (2012), Ulrich (2013)	
Patient education and engagement	10	Berry (2013), Coleman (2010), Jaen (2010)	Anderson (2012), Nelson (2014), Taliani (2013)	Carvajal (2014), Heyworth (2014), Kennedy (2013), Takane (2012)
Care plan development and progress; goal setting	9	Alidina (2014), Berry (2013), Coleman (2010), Day (2013), Hearld (2013), Yoon (2013)		Carvajal (2014), Hays (2014), Stevens (2010)
Self-management support; disease management	15	Alidina (2014), Friedberg (2009), Hearld (2013), Rittenhouse (2012), Rittenhouse (2011)	Anderson (2012), Khanna (2014), Lewis (2012), Nelson (2014), Taliani (2013), Ulrich (2013)	Hays (2014), Kern (2013), Lebrun-Harris (2013), Stevens (2014)
Medication management and education	10	Coleman (2010), Day (2013), Hearld (2013), Yoon (2013)	Anderson (2012), Khanna (2014), Nelson (2014)	Hays (2014), Heyworth (2014), Kennedy (2013)
Electronic prescribing	4	Alidina (2014), Hearld (2013), Rittenhouse (2012), Rittenhouse (2011)		
Communication and coordination				
Communication with patients	9		Ferrante (2010), Lewis (2012)	Carvajal (2014), Hays (2014), Heyworth (2014), Kern (2013), Lebrun-Harris (2013), Mead (2014), Van Berckelaer (2012)

Measure	N	Perspective		
		Practices / Clinics	Providers / Staff	Patients
Coordination of care and communication among staff/team	6	Day (2013)	Anderson (2012), Lewis (2012)	Bruder (2010), Kennedy (2013), Takane (2012)
Coordination, communication, and getting appointments with other providers and specialists	10	Alidina (2014), Berry (2013), Birnberg (2011), Coleman (2010), Yoon (2013)	Anderson (2012), Lewis (2012)	Jaen (2010), Schmidt (2013), Takane (2012)
Referral and use of community resources	9	Berry (2013), Ferrante (2010), Day (2013), Goldberg (2009), Hearld (2013)	Khanna (2014), Lewis (2012)	Stevens (2014), Van Berckelaer (2012)
Provider is informed / up-to-date about care from other providers	5			Hays (2014), Heyworth (2014), Hochman (2013), Maeng (2013), Nelson (2014)
Electronic access and sharing of information with other providers, hospitals, EDs, specialists	4	Hearld (2013), Rittenhouse (2012), Rittenhouse (2011), Yoon (2013)		
Continuity				
Continuity of care	9	Berry (2013), Day (2013), Goldberg (2009), Nelson (2014), Rosland (2013)		Ferrante (2010), Hochman (2013), Moore (2013), Schmidt (2013)
Team-based care				
Team huddles; team collaboration; team shares responsibility for care	8	Berry (2013), Day (2013)	Anderson (2012), Aseltine (2010), Ferrante (2010), Nelson (2014), Taliani (2013)	Takane (2012)

Measure	N	Perspective		
		Practices / Clinics	Providers / Staff	Patients
Specially-trained staff to assist patients in chronic disease self-management	3	Berry (2013), Friedberg (2009), Rittenhouse (2012)		
Care management and other tasks performed by RN care manager or nonclinicians	16	Alidina (2014), Berry (2013), Coleman (2010), Day (2013), Ferrante (2010), Goldberg (2009), Rittenhouse (2011), Rosland (2013)	Aseltine (2010), Driscoll (2013), Khanna (2014), Martinez-Gutierrez (2013), Nelson (2014), Taliani (2013)	Maeng (2013), Mead (2014)
Follow-up				
Reminders for appointments, follow-up, or tests	8	Alidina (2014), Birnberg (2011), Coleman (2010), Friedberg (2009), Hearld (2013), Nocon (2012)	Lewis (2012)	Nelson (2014)
Follow-up processes in place	12	Berry (2013), Coleman (2010)	Ferrante (2010), Martinez-Gutierrez (2013)	Carvajal (2014), Hochman (2013), Jaen (2010), Kennedy (2013), Kern (2013), Maeng (2013), Nelson (2014), Stevens (2014)
Tracking of care, test and lab results, referrals	10	Alidina (2014), Hearld (2013), Jaen (2010), Rittenhouse (2012)	Anderson (2012), Ferrante (2010), Ulrich (2013)	Hays (2014), Hochman (2013), Jaen (2010), Kennedy (2013)
Alerts for providers when patients are hospitalized or for needed services	5	Birnberg (2011), Hearld (2013), Nocon (2012), Rittenhouse (2012)	Khanna (2014)	
Post-discharge follow-up	7	Berry (2013), Day (2013), Hearld (2013), Rosland (2013), Yoon (2013)	Khanna (2014)	Nelson (2014)

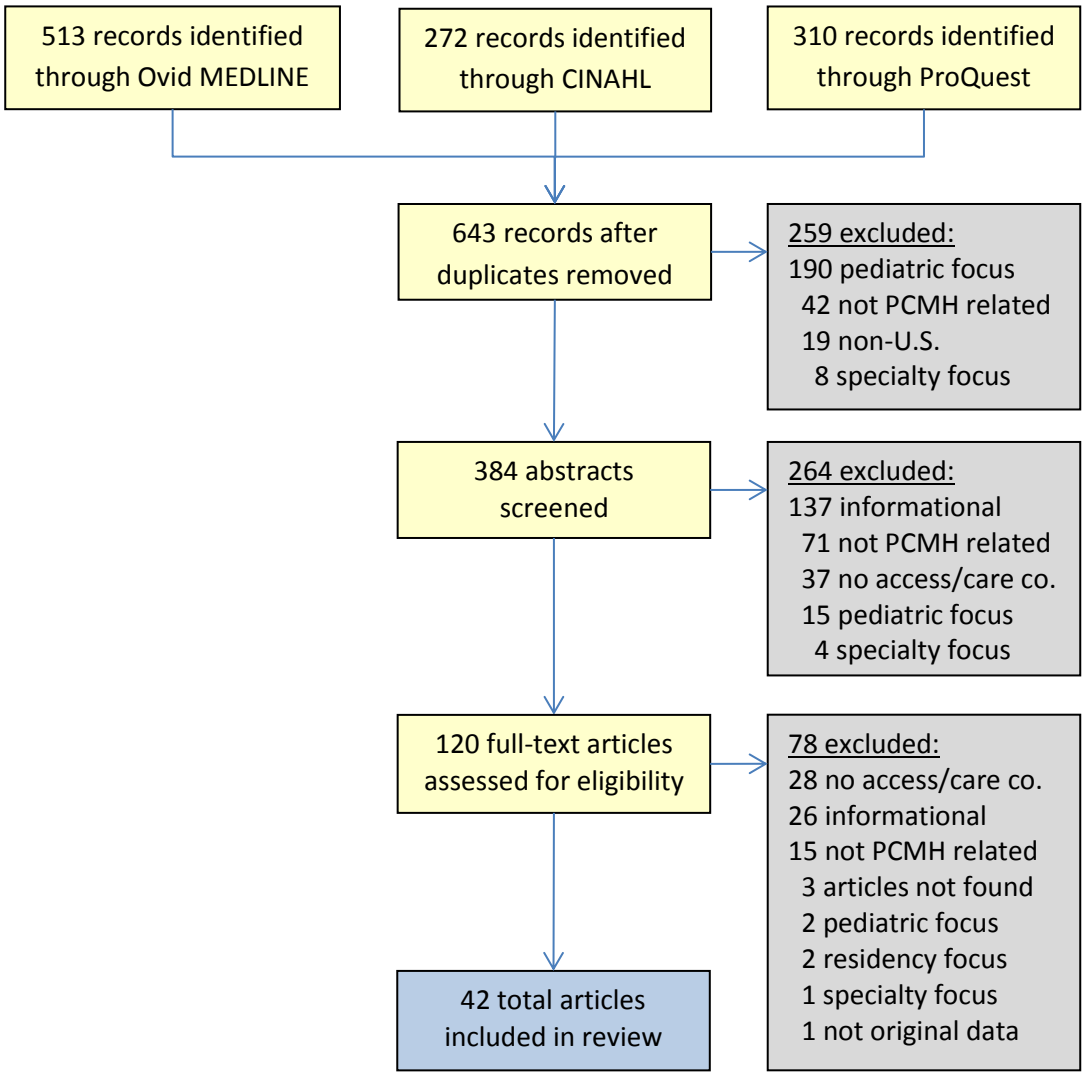


Figure 1: Flow diagram of PCMH literature review.

CHAPTER III: TRENDS IN CARE DELIVERY BY ASSOCIATE CARE PROVIDERS

Introduction

Efforts to improve patient access to comprehensive, quality primary care have promoted team-based care models, such as the Patient Centered Medical Home (PCMH), as best-practice approaches for care delivery. Team-based care involves the delineation and maximization of roles among team members, who include Primary Care Providers (PCPs), such as physicians, nurse practitioners (NPs) and physician assistants (PAs), and Associate Care Providers (ACPs), such as nurses, pharmacists, and social workers. As the number of annual primary care visits in the U.S. is expected to increase over the next several years (Dall et al., 2013; Hofer, Abraham, & Moscovice, 2011), and the shortage of primary care physicians is projected to worsen (Colwill, Cultice, & Kruse, 2008; Kirch, Henderson, & Dill, 2012), team-based care offers a promising avenue for increasing the capacity and efficiency of clinical sites to provide primary care as well as reducing associated costs by fully utilizing all members of the team, including less expensive personnel. This is accomplished through shared responsibility for providing care, whereby the workload is distributed within teams to leverage each member's unique skills (Garson, 2013; Ghorob & Bodenheimer, 2012b). Team members collaborate to allocate the most appropriate personnel to specific tasks,

and each member is encouraged to work to the full extent of his or her license and training (Solimeo et al., 2013).

Well-functioning team-based care is a key component of the foundation for high-performing primary care (Bodenheimer, Ghorob, et al., 2014). The drive for team-based care has presented opportunities for ACPs to take a more prominent role in primary care delivery. Within the PCMH context, ACP roles in care delivery have been enhanced, with an emphasis on providing services, such as patient education, chronic illness care, medication management, preventive care and health screening, and care coordination, either as supplementary to, or as substitution for those provided by PCPs. The utilization of ACPs to deliver such care appears to be more prevalent in primary care settings with a high level of PCMH functioning, as compared to those at a lower level (Scholle, Saunders, Tirodkar, Torda, & Pawlson, 2011), while underutilization of ACPs has been identified as a major barrier to PCMH implementation (Nutting, Crabtree, & McDaniel, 2012).

The involvement of ACPs in care delivery can increase patients' access to needed services and lessen the workload burden on PCPs. Moreover, the transition of some care activities from PCPs to ACPs has been supported in the literature. For example, in a recent study, physicians who reviewed recordings of 121 patient visits to a PCP determined that approximately 38% of PCP time spent on activities during the visits could potentially be reassigned to a non-PCP (Pelak, Pettit, Terwiesch, Gutierrez, & Marcus, 2015). Furthermore, ACPs perform many tasks autonomously. Previous studies have shown that nurses can independently and successfully treat a substantial portion (63-72%) of patients presenting to primary care for minor illnesses (Fabrellas et

al., 2013; Iglesias et al., 2013). The inclusion of pharmacists and social workers in primary care teams has also been described and promoted (Allen, 2012; Jorgenson, Laubscher, Lyons, & Palmer, 2014; Smith, Bates, & Bodenheimer, 2013; Sommers et al., 2000).

Although studies have begun to highlight the important role of ACPs in primary care delivery, there is scant information in the literature about the proportion of care performed by ACPs or how this care is distributed among various types of providers. Previous research has primarily evaluated care delivery at a PCP level, comparing NP- and PA-delivered care to that of physicians (Aparasu & Hegge, 2001; Dahrouge et al., 2014; Everett et al., 2013; Hooker & McCaig, 2001; Morgan et al., 2012). Few studies have quantified ACP-delivered care. Importantly, little is known about whether care delivery among PCPs and ACPs has changed with the expanding use of PCMH in primary care settings.

Primary care in the Veterans Health Administration

As the largest integrated healthcare system in the nation, the Veterans Health Administration (VHA) offers a unique opportunity to study the distribution of primary care clinical encounters across several different types of providers and across a large sample of primary care sites. In April 2010, the VHA introduced a PCMH initiative, called Patient Aligned Care Teams (PACT) (Klein, 2011). Within PACT, patients are cared for by teamlets, each comprised of one full-time equivalent PCP, one RN care manager, one LPN or medical assistant, and one administrative clerk (Department of Veterans Affairs, February 5, 2014; Rosland, Nelson, et al., 2013). Additional primary care-based team members are suggested at staffing ratios of one clinical pharmacy

specialist for approximately every three teamlets, one social worker for about every two teamlets, and one registered dietitian for approximately 6,000 patients (Department of Veterans Affairs, February 5, 2014).

Several VHA studies have evaluated the implementation of PACT, describing the challenges and barriers to building effective teams, and the effect of PACT on select outcomes (Forman et al., 2014; Helfrich et al., 2014; Nelson et al., 2014; Piette et al., 2011; Rosland, Nelson, et al., 2013). Two studies in particular offer a preliminary look at ACP-delivered care in VHA. Prior to PACT, Morgan et al. (2012) estimated that approximately 28% of encounters listed an ACP as the primary individual providing the care, representing a substantial portion of documented care performed by ACPs. However, as their focus was on primary care delivery by MDs, NPs, and PAs, ACP encounters were excluded from analyses (Morgan et al., 2012). In an evaluation of PACT-related changes occurring nationally, Rosland et al. (2013) reported quarterly in-person and phone encounters occurring between 2009 and 2012 by different types of providers. Their findings of slightly decreasing in-person quarterly PCP encounters, coupled with increased phone encounters among both PCPs and ACPs, suggest at least some shift in how care was delivered after the introduction of PACT.

Objective

Expanding on this initial work, we examined trends in clinical encounters provided by PCPs and a full range of ACPs in VHA in a longitudinal observational study using patient encounter data pre-PACT to 2013. Our aims were: 1) To describe how documented primary care encounters are distributed across different types of providers

and across community- and hospital-based primary care sites; and 2) To determine if this distribution has changed since VHA's implementation of PACT in 2010.

Methods

We conducted a longitudinal retrospective analysis, with primary care site as the unit of analysis. This study was reviewed and approved by the University of Michigan and the Veterans Affairs Ann Arbor Healthcare System Institutional Review Boards. Data was obtained from the VHA Corporate Data Warehouse (CDW) for the five-fiscal year (FY) period of October 1, 2008, through September 30, 2013. A detailed description of the data used for this study is provided below.

Primary care sites

We obtained a list of all VHA facilities and their corresponding information from CDW files. This data included a unique identifier for each facility, the type of facility and its geographic location, and the affiliated Veterans Integrated Service Network (VISN: the regional grouping of VHA facilities) identifier. VHA primary care clinic sites include two types: Community Based Outpatient Clinics (CBOCs), which are located separately from a medical center, and Veterans Affairs Medical Centers (VAMCs), which are located within a medical center. We selected facilities with CBOC or VAMC designation and linked them to outpatient data to ascertain their primary care clinical encounters that had occurred during the five-year study period. Sites were also linked to the VHA patient assignment records to determine their patient populations. For inclusion in the study, we stipulated that sites had to have at least 500 primary care encounters in each of the five FYs in the study period, which corresponds to VHA's definition of a primary care site (Department of Veterans Affairs, December 30, 2013), and at least 100

primary care patients. There were 155 Veterans Affairs Medical Centers (VAMCs), and 609 Community Based Outpatient Clinics (CBOCs) that met these criteria.

Patient population

The study population included veteran patients aged 18 years and older. We used data from the VHA's Primary Care Management Module (PCMM) to identify the patient populations in each site over the five study years. The PCMM is a continuous process, whereby each patient is assigned to a single PCP at a specific primary care site (Department of Veterans Affairs, April 21, 2009). Patients are assigned at the time of their first primary care appointment. Established patients who have not been seen by their assigned PCP within the previous 24 months are removed from the PCP's assigned group of patients. Thus, assigned patients have had at least one primary care encounter with their PCP within a two-year period. Patient-PCP relationships can change over time, and assignments are updated as needed. PCMM coordinators validate the accuracy of assignment data monthly for routine performance reporting purposes (Department of Veterans Affairs, April 21, 2009). Assignment begin and end dates permitted the determination of a monthly denominator population of assigned patients for the PCPs in each of the primary care clinic sites during the five study years. A patient could contribute to the population denominator for multiple sites in a given year. Approximately 4% of patients each year had assignments to more than one site during the given year.

Primary care encounters

Patient encounters are professional contacts between a patient and a provider (Department of Veterans Affairs, December 30, 2013), and are documented using

specific classification “stop codes”, which designate the type of care provided (Department of Veterans Affairs, May 29, 2013). All primary care encounters that occurred during the five study years for the assigned patients in the clinic sites (i.e., encounters for non-assigned patients were not included) were obtained from CDW outpatient data. Twenty individual stop codes define primary care activity, and these are grouped into seven categories: home based primary care, mental health, geriatric primary care (GeriPACT), telephone encounters, shared appointments, women’s health, and primary care/medicine (FIGURE 2). Because the focus of this study was on regular primary care activity, we only selected in-person primary care encounters designated as primary care/medicine visits (VHA stop code 323). Telephone encounters, and those in the other five categories, which were considered specialty primary care, were excluded. Primary care/medicine was the largest category of primary care encounters for CBOCs and VAMCs, and represented 94% of all primary care encounters among all sites in FY2009, 92% in FY2010, 91% in FY2011, 69% in FY2012, and 64% in FY2013. The decrease in percentage during the last two years was due to the introduction and use of the primary care telephone encounter code.

Immunization activities comprise a large portion of nurse encounters during the fall influenza season (September, October, November). Thus, in order to identify encounters related to immunization, we linked the encounters to their Current Procedural Terminology (CPT) codes located in the CDW outpatient procedures file.

Providers

VHA encounters document the primary provider responsible for delivering the clinical encounter, and sometimes a secondary provider (present for 28% of the

encounters). The primary provider was missing for less than 0.009% of encounters each year, and these were excluded. We categorized encounters according to the job classification of the primary provider. PCPs included physicians with a medical specialty of family medicine, family practice, general practice, internal medicine, geriatrics, and obstetrics and gynecology. Additionally, NPs and PAs, who can function as PCPs in VHA, and medical residents were also included as PCPs. ACPs included the following provider classifications: clinical nurse specialists (CNSs), registered nurses (RNs), licensed practical nurses (LPNs), nursing assistants (NAs) or technicians, clinical pharmacists or pharmacy technicians, social workers, dietitians or nutritionists, and behavioral health providers. Less than 1.2% of the encounters in each year listed a type of provider other than those listed above, and were excluded from analyses.

Analyses

Development of initial datasets and queries was conducted using SQL Server Management Studio 2012 (Microsoft Corporation). Further data management, including merging data to create analytic datasets was completed in SAS 9.3 (SAS Institute Inc., Cary, NC). Unique counts of observations, frequencies and descriptive statistics of the variables were calculated to identify duplicates and ensure accuracy of conditional data pulls and merges of datasets. Analyses were conducted at the clinic site level.

We compared patient characteristics, including gender, age, race, and ethnicity, by type of site (CBOC vs. VAMC) for the five years. Gender and age were available for almost all selected patients; however, race and ethnicity were missing for 17% and 11% of patients, respectively. Missing race and ethnicity data were slightly more common among CBOC than VAMC sites.

Previous PCMH studies have shown that small clinical sites are disadvantaged in their ability to implement PCMH-related components, such as team-based care, and are less likely to utilize ACPs to perform care activities as compared to larger sites (Nutting et al., 2012; Rittenhouse et al., 2011). Thus, we used the number of patients as an indicator of the size of the clinical site. Because older patients are likely to have more and/or complex medical needs, which may influence workload distribution among providers, the percentage of patients who were 65 years and older was also calculated for each site.

To evaluate overall national trends in care delivery, we calculated the annual encounters by type of provider and type of site in three ways: 1) as a count, representing an absolute volume of encounters; 2) as a rate per 1,000 patients, representing volume adjusted for population size; and 3) as a percentage of total encounters, representing a relative proportion of encounters with PCPs and ACPs.

In multivariate analyses, we examined the relationship between site characteristics and encounters by modeling the monthly site-level encounters separately for each type of provider. We found the number of encounters for each type of provider was positively skewed with substantial overdispersion. Overdispersion is a common phenomenon with count data whereby the observed counts have variability that far exceeds predicted values (i.e., standard deviation is much larger than the mean), and may result in underestimated standard errors and incorrect interpretation of the estimates if not accounted for in the regression model (Fitzmaurice, Laird, & Ware, 2004). Thus, we employed negative binomial models with a log link function, which incorporates an additional source of random variability to allow for overdispersion

(Fitzmaurice et al., 2004). The number of patients in each month for the sites was the offset denominator for the encounter rates. The generalized estimating equation (GEE) implemented in the GENMOD procedure in SAS 9.3 (SAS Institute Inc., Cary, NC) was used with an autoregressive correlation structure to account for correlation between time points within-site.

We did not impute zeros for any months without encounters for particular providers, because the presence of each type of provider—and thus, opportunity for an encounter—was not known for each site. Independent variables included in the models were time (in months), a binary flag indicating the period of time during vs. before the PACT implementation in April 2010, an interaction of time and PACT indicator, type of site (CBOC vs. VAMC), the number of patients at the site and the percentage of patients 65 years or older in the site. Models specified that sites were nested within the 21 VHA-defined geographic regions. Given the limited variation of gender, race, and ethnicity, as well as the sizable missing data for race and ethnicity, these variables were not included in multivariate analyses.

Model diagnostics, including Cook's distance and leverage, were examined for the presence of potentially influential outliers. Using an iterative process, changes in the coefficients with deletion of potential outliers were evaluated. The goodness of fit Quasi-likelihood under the Independence model Criterion (QIC) was used to determine model fit. It was noted that a large spike in RN and LPN encounters occurred in October of each year, and to a lesser extent September and November. Per review of CPT codes, this seasonal pattern was attributable to immunization administration, most often influenza immunization. Immunizations accounted for 11% of RN encounters and 18%

of LPN encounters during the five years. In order to see the effect seasonal immunizations had on the RN and LPN encounter trends, separate regression models were estimated with and without the encounters related to immunization.

The rate ratios (RRs) calculated from the beta estimates of time in the negative binomial models compare the expected number of encounters in a month to that of the previous month. Thus, an RR value >1 indicates that the encounter rate increased over time, whereas a value <1 indicates the monthly rate decreased, holding other covariates constant. Likewise, a 95% confidence interval (CI) that is inclusive of 1 means that the change in rate over time was not statistically significant. The beta estimates for the time*PACT interaction term represents the comparison of the RRs associated with time during PACT compared to the RRs associated with time pre-PACT. A significant beta estimate for the time*PACT interaction indicates that the change in rate during PACT was significantly different than the change in rate pre-PACT. For those provider types that had a significant time*PACT interaction, the RR for the period of time during PACT was calculated and reported. Finally, the predicted monthly rates derived from the regression models were adjusted by weighting them by the size (number of monthly patients) of the sites, and are displayed by type of provider.

Results

The assigned Veteran population among the 764 examined VHA primary care sites increased during the five years, from 4.3 million (2.1 million in CBOCs and 2.2 million in VAMCs) in FY2009 to 5.2 million (2.7 million in CBOCs and 2.5 million in VAMCs) in FY2013 (TABLE 4). This represented a population growth of 26% among CBOCs, and 14% among VAMCs. The median number of patients in CBOC sites

increased from 2,633 in FY2009 to 3,372 in FY2013, and increased from 13,271 in FY2009 to 14,984 in FY2013 in VAMC sites. The monthly growth in the total number of patients included in the study among CBOCs and VAMCs is shown in FIGURE 3. The patient population in CBOCs continued to increase over the five study years, while the VAMC patient population increased during the first three years and was relatively stable during the last two years of the study. The distribution of the number of patients per site varied widely among VAMCs, which ranged from sites having less than 1000 patients to a site with more than 48,000 patients (FIGURE 4). Conversely, the distribution of the number of patients among CBOCs was more tightly clustered, with most having less than 10,000 patients.

The study patients were primarily male, non-Hispanic, and white, with VAMC sites having slightly more diversity in these demographics (TABLE 4). Less than 3% of patients in both CBOCs and VAMCs were of other races, and are not reported here. CBOCs had slightly higher proportions of patients 65 years and older each year, which represented half (50.2%) of their population in FY2013, compared to 43% for VAMCs. The assigned populations for the sites were quite stable over time—about 96% of patients each year were assigned to only one site during the year.

The annual number of encounters, encounter rates per 1000 patients, and percentages of total encounters for each type of provider are reported in TABLE 5 and TABLE 6. The overall number of in-person encounters decreased during the five years. This decline was primarily among PCPs, whose encounters decreased from 8.4 million in FY2009 to 7.2 million in FY2013. In fact, the number, rate, and percentage of encounters for all PCPs decreased in both CBOCs and VAMCs over the five years. The

encounter rates for physicians and NPs tended to be slightly higher in CBOCs than VAMCs, whereas resident encounters were much more prevalent in VAMCs.

Conversely, overall, ACP-delivered encounters increased from 3.4 million to 3.9 million, representing 29% of all encounters in FY2009 and 35% in FY2013. Much of this increase was among CBOCs, where the number of encounters increased from 1.5 million in FY2009 to 1.9 million in FY2013 (a 26% increase), as compared to an increase from 1.9 million to 2.0 million (a 10% increase) among VAMCs. RNs and LPNs were responsible for the largest portion of ACP encounters, representing 24% of encounters in FY2009 and almost 30% in FY2013. RNs and LPNs had an initial drop in encounter rates in FY2010, which subsequently increased over time. RN encounter rates were highest in VAMCs, but LPN and NA encounter rates were higher among CBOCs. Encounter rates and proportions for pharmacists, social workers, dietitians, and behavioral health providers were higher in VAMCs as compared to CBOCs. Social workers and dietitians had increasing encounters during the five years. The number of pharmacist encounters decreased in VAMCs, while increased among CBOCs. Overall, the primary care sites as a group increased their proportion of encounters delivered by ACPs from the first to the last study year (FIGURE 5).

The unadjusted monthly rates of in-person encounters per 1000 patients for each type of provider are displayed in FIGURE 6. The monthly rates for PCPs appear to have decreased over time, whereas those for RNs and LPNs have very slightly increased. Noticeable is the large seasonal spikes that occur exclusively in the RN and LPN rates. After excluding all encounters with a CPT code indicative of an immunization service, the large spikes substantially diminished, but were not entirely eliminated (FIGURE 7).

In multivariate analyses, we found that the predicted monthly encounter rates for each of the four types of PCPs significantly decreased over the time period, after controlling for other variables (TABLE 7). Similarly, encounter rates for several types of ACPs, including CNSs, RNs, LPNs, NAs, and pharmacists, all significantly decreased in the pre-PACT period. However, interacting time with PACT revealed a subsequent significant increase in encounter rates during PACT implementation for RNs, LPNs, and social workers. Thus, although prior to PACT, the RRs for most of the providers indicated a decreasing trend in encounters, the introduction of PACT significantly altered the trajectory of encounter rates for some ACP types (especially nurses), but not PCPs.

After removal of encounters related to immunizations, the RRs for RN and LPN encounters remained significant for an increasing rate during the period of PACT implementation, although with slightly less magnitude. For example, the RR for all RN encounters during PACT was 1.009, which represents a 0.9% increase in the predicted monthly rate of encounters per 1000 patients. With the removal of immunization-related encounters, the RR decreased to 1.007, representing a 0.7% increase in the monthly encounter rate. Findings were similar for LPNs. Thus, although significant, the increase in encounter rates during PACT implementation for RNs and LPNs, as well as for social workers, was modest.

The regression models also identified some other significant relationships between encounter rates and site-level factors. Consistent with the summary of annual encounters, the multivariate models found that residents, pharmacists, and social workers in CBOCs had significantly lower monthly rates of encounters as compared to

those in VAMCs; whereas NPs and PAs in CBOCs had significantly higher rates than those in VAMCs (data not shown). Additionally, as the percentage of patients aged 65 and older increased, physician encounters decreased, while the encounter rates of NPs and PAs increased.

The adjusted predicted monthly rate of encounters per 1000 patients for each type of provider is displayed in FIGURE 8. To better visualize the trends, FIGURE 9 shows the encounter rates for only PCPs. The monthly encounter rate for each PCP significantly decreased during the five years, and was not significantly different pre-PACT compared to during PACT implementation. Physicians had the highest encounter rates among all provider types. The monthly rates for ACPs are displayed in FIGURE 10. RNs had the highest encounter rates among ACPs, followed by LPNs. Although RNs and LPNs experienced decreasing rates pre-PACT, their encounter rates had a slight increasing trajectory during the period of PACT implementation. Non-nursing ACPs had the lowest encounter rates, which are more easily visualized in FIGURE 11, after expanding the Y axis. Pharmacists and pharmacy technicians had a decreasing rate during the five years, and this trend was not significantly different during PACT implementation compared to pre-PACT. However, the monthly rate for social workers significantly increased during PACT implementation. Dietitians and behavioral health providers both had relatively stable monthly encounter rates.

Lastly, the predicted monthly encounter rates for RNs and LPNs estimated with and without encounters for immunizations are provided in FIGURE 12. The large amount of immunization activity that occurred at the beginning of the study period in October 2008 appeared to have substantially influenced the trend lines for RNs and LPNs during

the pre-PACT period, causing a steep decline in the slope. However, the trends lines with and without immunizations for the time period during PACT implementation were fairly similar.

Discussion

This work yields important information about the documented clinical activity of multidisciplinary providers, which has not been previously quantified to this scale. Although other studies have indirectly measured ACP care (Druss, Marcus, Olfson, Tanielian, & Pincus, 2003), we were unable to find any literature that measured documented care by multiple types of ACPs from routinely-collected health systems data to this level of detail. As the largest, integrated healthcare system in the nation, VHA was advantageous as an expansive source of documented patient encounters, permitting the evaluation of care activities by multiple provider types across many individual primary care sites.

Our study found that a sizable portion of primary care encounters is provided by health care personnel other than PCPs, and that this proportion has increased over time (from 29% to 35% during the five years). This is consistent with Morgan et al. (2012) who estimated that prior to PACT, from 2005-2010, about 28% of VHA primary care encounters were provided by non-PCPs. Notably, we followed the same cohort of primary care sites over five years. These sites experienced growth in their populations during this time, which may account for some increases in the utilization of various types of providers. Furthermore, the expanded use of providers did not appear to be among NPs or PAs, but rather among ACPs, as evidenced by increasing encounter rates among nurses and social workers.

In the closest comparison to our study, Rosland et al. (2013) examined national, quarterly trends of in-person, VHA encounters occurring between 2009 and 2012 among PCPs, RNs, LPNs, and pharmacists. Similar to our study, the results suggested a decreasing trend in PCP encounters; however, they found no significant trends in RN and LPN encounters (Rosland, Nelson, et al., 2013). In our current study, which extended the aforementioned study by an additional year of data, we found a significant increase in RN and LPN rates after the introduction of PACT. The roll-out of PACT in 2010 necessitated substantial changes in staffing across VHA, in part, because of the required formation of teamlets. VHA increased its primary care support staff by over 3,000 full-time equivalents, which included the hiring of almost 1,300 RNs (Rosland, Nelson, et al., 2013). The increased focus on team-based care, coupled with the reorganization and hiring of nursing staff for PACT teamlets, may have enabled RNs and LPNs to assume a greater role in care delivery, and may explain some of the increase in encounter rates that we found after FY2010.

Importantly, PACT implementation also encouraged the use of alternative modes of care—namely, telephone encounters. Although telephone encounters were not included in these analyses, we did note documentation of them beginning just prior to FY2012, with substantial increased use thereafter. Likewise, Rosland et al. (2013) found increasing telephone encounters among PCPs, RNs, LPNs, and pharmacists during FY2011 and FY2012. It is possible that this shift in mode of care delivery may account for at least some of the reduction in the in-person encounters among PCPs in our data. And ACPs—especially nurses—appear to have experienced increases in both in-person

and telephone encounters. Thus, the redistribution of workload may have occurred not only at a provider level, but also across delivery mechanisms.

Interestingly, over one-third (35%) of the PCP encounters we identified had a secondary provider documented on the encounter. This is in contrast to the VHA study by Morgan et al. (2012), who found that less than 2% of PCP encounters during 2005-2010 had a secondary provider listed. It may be possible that PACT brought about changes in how encounters were delivered and documented, which may have increased the presence of ACPs on encounter records. In addition, the third most frequent CPT procedure code among encounters by physicians, NPs, and PAs was immunization administration. Given that RNs and LPNs typically perform this function, it is likely that at least some of these encounters were coded in the traditional manner whereby the PCP is listed first on the encounter, regardless of which provider actually delivered the care. This would suggest that our counts of ACP-delivered encounters may be underestimated.

On the other hand, among the ACP encounters we studied, only 11% listed a secondary provider. Thus, while PCP encounters frequently involved other providers, almost 90% of ACP encounters primarily consisted of activities that appeared to be performed independently. Previous studies of nurses in primary care settings found that successful management and resolution of minor illnesses among patients requiring same-day care was achieved without physician intervention in as much as 63% to 73% of cases (Fabrellas et al., 2013; Shum et al., 2000). Our data would support that ACPs do perform autonomous functions in care delivery.

Consistent with the literature, we found that the presence of encounters among some ACPs, such as dietitians, was not as prominent as nursing staff, especially among CBOCs, which tend to be smaller than VAMCs. Larger clinical sites and those that have achieved PCMH status are more likely to have and utilize a variety of ACPs, including some less common types (Peikes et al., 2014).

Implications

We note several important implications of this research. First, the VHA PACT model aligns with PCMH in most of its attributes, including the development of interdisciplinary teams that share care responsibilities, the redistribution of workload across various providers, and the increased use of ACPs to independently provide services to patients. Thus, primary care encounter delivery in VHA is relevant to the larger PCMH community. The promotion of team-based care within the PCMH context creates a need for further exploration of ACP roles in care delivery. The success of teams relies on a division of labor that maximizes individual provider roles and results in optimal patient outcomes.

Second, our evidence suggests that the proportion of care delivery attributable to ACPs has increased over time, which would support that core PACT changes have occurred to some extent. However, previous research has described a shift in care delivery from physicians to nonphysician providers beginning as early as the 1990's (Druss et al., 2003). The extent to which PCMH implementation drives or contributes to the continuing shift in care delivery among providers is not known.

Third, ACPs are crucial to meeting the needs of patients in an ever-changing health care environment. The U.S. population is aging (Vincent, 2010) and increasingly

burdened with chronic illness, presenting with complex health care needs. By 2019, the demand for primary care is projected to increase the nation's annual primary care visits between 15-24 million, in part due to the Patient Protection and Affordable Care Act (Hofer et al., 2011). This demand will require an expanded physician workforce (Colwill et al., 2008; Dall et al., 2013; Hofer et al., 2011). Yet, the number of physicians choosing primary care as a specialty has been steadily declining (Jeffe, Whelan, & Andriole, 2010). A highly promoted strategy to address this primary care supply and demand imbalance is to maximize the practice scope of other PCPs—NPs and PAs—as well as facilitate the involvement and autonomy of ACPs in providing clinical services (Bodenheimer & Smith, 2013; Bodenheimer, Willard-Grace, & Ghorob, 2014; Ghorob & Bodenheimer, 2012a, 2012b; Kirch et al., 2012; Pelak et al., 2015; Porter, Pabo, & Lee, 2013; Tubbesing & Chen, 2015). Fully utilizing ACPs in care delivery can broaden the supply of providers available to patients, and improve patients' access to needed services.

Finally, our study is an initial step in measuring ACP-delivered care from routinely collected data. Health system data from clinical patient encounters are frequently used in calculations of performance measures. However, measurement approaches have historically focused almost exclusively on PCP-related care, including access to care (often measured by a patient's ability to get an appointment with his/her PCP when needed) and continuity of care (measured by the proportion of total visits that a patient has with his/her PCP). As team-based care becomes the norm in primary care settings, it may be time to rethink what should be included in performance measures. When a patient with an urgent need is able to gain same-day access to a nurse on his/her care

team, or is able to meet with a pharmacist for medication management, should the emphasis be on whether or not the patient saw a PCP during the visit, or whether the patient's needs were appropriately met by a member of the team?

In recent years, there has been momentum to update documentation practices to be more inclusive of ACP activities. For example, VHA recently modified the PCMM patient assignment process to link patients to teams rather than individual PCPs, which will permit the compilation and reporting of performance measures by team. PCMH measures nationally are being redesigned to reflect team-based care. New procedure codes (T codes) have been created to designate the provision of nursing services. And the Centers for Medicare and Medicaid Services have created new funding mechanisms to reimburse certain care management services provided by nonphysicians (American Academy of Family Physicians, Nov 5, 2014). Thus, it is imperative to better understand the full extent of care being delivered by all providers in primary care, and how to access and use existing data sources to ascertain ACP-delivered care.

Limitations

This research has some limitations. In particular, with the available data we cannot determine whether increases in ACP encounters were due to increasing workload for ACPs or improved documentation of ACP encounters as encouraged by PACT. Most likely, both events contributed to the findings and regardless of which played a larger role, it is clear that ACPs shared a substantial portion of care with PCPs. Moreover, it is possible that some of the PCP encounters were actually delivered by ACPs, depending on the documentation practices occurring at individual sites. The tendency of listing the PCP versus other provider types when recording encounters may

have led to undercounting of ACP encounters. Nevertheless, potential changes in how encounters were documented over time would have impacted the ACP encounters in this study.

It is also important to note that measuring the amount of ACP encounters is not equivalent to measuring the quality of care during the encounters. Additionally, the measurement of encounters lacks a target or goal—i.e., the optimal proportion or rate of ACP-delivered care that provides value, maximizes efficiency, and contributes to good outcomes for patients, is not known. Furthermore, documented encounters are merely one source of workload for providers, as there are many other aspects of clinical care that do not get recorded but are also meaningful. We also did not ascertain the number of providers in each site. Therefore, infrequent encounters for a particular type of provider is not necessarily indicative of underutilization of that provider type in a site, but may likely be a factor of the provider not being present. In addition, this analysis only included the most frequently-used primary care stop code for in-person visits, which is a portion—albeit a substantial proportion—of the total encounters provided in the primary care sites. Nonetheless, this may have disproportionately affected the types of providers who function in more of an expanded team member role, such as behavioral health providers or dietitians, who may utilize other stop codes more frequently than the one included here.

The Veteran patient population is primarily comprised of older adult males, which may limit the generalizability to the U.S. population. However, our findings are quite relevant to other primary care sites that care for large numbers of older adults with chronic illness, who tend to be high consumers of primary care. Similar to these patient

groups, Veteran patients have high prevalence of chronic illnesses (Yoon, Scott, Phibbs, & Wagner, 2011; Yu et al., 2003), thus, ACPs in VHA primary care sites likely spend a sizable amount of time providing chronic care, which is a key focus of most PCMH programs.

Conclusions

It is evident that ACPs play an important role in primary care delivery, whether supplementary to, or independent of PCPs. As national interest in team-based care processes is increasingly promoted in quality improvement initiatives, it is important that the contributions of all team members are recognized and reflected in health care policies and measurement approaches to improve quality and outcomes. This work is an initial step toward providing a more complete picture of primary care by specifically measuring documented ACP activities.

Table 4: Characteristics of the Veteran study population among CBOC (n=609) and VAMC (n=155) primary care sites*, by fiscal year.

Characteristic		FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total unique Veterans† in study, n	CBOC	2,128,526	2,381,046	2,517,338	2,648,513	2,686,233
	VAMC	2,206,055	2,379,369	2,537,066	2,551,121	2,514,754
Median number of patients (range)	CBOC	2,633 (137-18,946)	2,972 (157-21,938)	3,179 (170-25,501)	3,338 (227-26,502)	3,372 (232-29,033)
	VAMC	13,271 (701-43,049)	14,178 (953-46,025)	15,153 (1,233-47,240)	15,263 (851-46,881)	14,984 (860-48,300)
Male, %	CBOC	95.2%	94.9%	94.7%	94.5%	94.2%
	VAMC	94.0%	93.8%	93.5%	93.2%	92.9%
Median age, years	CBOC	64	64	64	64	65
	VAMC	61	62	62	62	63
65 years and older, %	CBOC	48.2%	47.4%	46.9%	47.7%	50.2%
	VAMC	40.0%	39.6%	39.5%	40.3%	42.9%
Race‡, %						
White	CBOC	86.9%	86.6%	86.2%	85.8%	85.4%
	VAMC	77.3%	76.8%	76.4%	76.0%	75.6%
Black	CBOC	11.1%	11.3%	11.7%	11.9%	12.3%
	VAMC	21.0%	21.4%	21.7%	22.0%	22.5%
Ethnicity‡, %						
Non-Hispanic	CBOC	95.3%	95.2%	95.0%	94.9%	94.8%
	VAMC	94.6%	94.5%	94.4%	94.1%	94.0%
Hispanic	CBOC	4.7%	4.8%	5.0%	5.1%	5.2%
	VAMC	5.4%	5.5%	5.6%	5.9%	6.0%

* Primary care sites included those CBOCs or VAMCs with at least 100 unique Veteran patients and 500 primary care encounters in each of the study years.

† Unique Veteran patients (each patient counted only once) meeting study criteria: 18 years or older at the beginning of a given FY, and assigned to one or more of the study primary care sites for one or more months during a given FY. The assigned population is a subset of the actual number of patients seen at a particular site.

‡ Percentage of patients with non-missing race/ethnicity. Less than 3% of patients had race other than White or Black for each year.

CBOC: Community Based Outpatient Clinic; FY: fiscal year; VAMC: Veterans Affairs Medical Center.

Table 5: Number and rate of primary care encounters* per 1,000 patients among CBOC (n=609) and VAMC (n=155) primary care sites, by fiscal year.

Type of provider	FY 2009		FY 2010		FY 2011		FY 2012		FY 2013	
	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000
Totals	11,731,188		11,693,793		11,521,914		11,283,082		11,177,709	
ACPs	3,352,654	765.6	3,253,150	672.2	3,529,230	677.6	3,806,728	718.0	3,934,480	743.7
PCPs	8,378,534	1913.3	8,440,643	1744.2	7,992,684	1534.5	7,476,354	1410.1	7,243,229	1369.0
CBOC										
ACPs	**1,500,193**	**698.2**	**1,521,160**	**629.3**	**1,664,020**	**635.6**	**1,788,377**	**663.1**	**1,897,463**	**695.0**
CNS	2,466	1.1	1,548	0.6	4,437	1.7	2,786	1.0	2,955	1.1
RN	766,591	356.8	780,157	322.7	845,355	322.9	922,659	342.1	967,950	354.5
LPN	550,266	256.1	550,911	227.9	621,686	237.5	654,132	242.5	704,964	258.2
NA / tech	32,639	15.2	25,368	10.5	24,949	9.5	26,243	9.7	26,921	9.9
Pharmacist / tech	109,523	51.0	119,726	49.5	119,165	45.5	123,432	45.8	136,754	50.1
Social Worker	28,783	13.4	32,772	13.6	37,251	14.2	42,982	15.9	43,745	16.0
Dietitian	5,367	2.5	5,678	2.3	6,557	2.5	10,645	3.9	9,782	3.6
Behavioral Health	4,558	2.1	5,000	2.1	4,620	1.8	5,498	2.0	4,392	1.6
PCPs	**4,120,802**	**1918.0**	**4,219,847**	**1745.7**	**4,027,908**	**1538.5**	**3,815,841**	**1414.9**	**3,731,421**	**1366.6**
Physician	3,019,423	1405.3	3,109,267	1286.3	2,944,605	1124.7	2,784,975	1032.6	2,734,437	1001.5
Resident	17,898	8.3	12,233	5.1	14,709	5.6	9,111	3.4	5,455	2.0
NP	744,550	346.5	781,275	323.2	753,277	287.7	720,162	267.0	696,359	255.0
PA	338,931	157.8	317,072	131.2	315,317	120.4	301,593	111.8	295,170	108.1
VAMC										
ACPs	**1,852,461**	**830.5**	**1,731,990**	**715.1**	**1,865,210**	**720.0**	**2,018,351**	**774.8**	**2,037,017**	**795.6**
CNS	10,967	4.9	6,592	2.7	5,778	2.2	3,992	1.5	2,850	1.1
RN	917,066	411.1	855,683	353.3	951,275	367.2	1,036,112	397.7	1,028,313	401.6
LPN	520,015	233.1	479,372	197.9	520,436	200.9	565,226	217.0	601,491	234.9
NA / tech	19,781	8.9	20,175	8.3	19,633	7.6	14,362	5.5	15,157	5.9

Type of provider	FY 2009		FY 2010		FY 2011		FY 2012		FY 2013	
	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000	n	Rate per 1000
Pharmacist / tech	273,086	122.4	258,835	106.9	252,309	97.4	263,295	101.1	248,916	97.2
Social Worker	81,352	36.5	79,261	32.7	83,351	32.2	93,017	35.7	100,755	39.4
Dietitian	21,565	9.7	23,667	9.8	22,278	8.6	28,724	11.0	29,420	11.5
Behavioral Health	8,629	3.9	8,405	3.5	10,150	3.9	13,623	5.2	10,115	4.0
PCPs	**4,257,732**	**1908.9**	**4,220,796**	**1742.7**	**3,964,776**	**1530.5**	**3,660,513**	**1405.2**	**3,511,808**	**1371.6**
Physician	3,037,849	1362.0	3,043,412	1256.6	2,874,250	1109.5	2,676,934	1027.6	2,596,085	1013.9
Resident	141,892	63.6	147,911	61.1	134,017	51.7	116,003	44.5	106,843	41.7
NP	721,608	323.5	701,917	289.8	658,557	254.2	599,457	230.1	568,708	222.1
PA	356,383	159.8	327,564	135.2	297,952	115.0	268,131	102.9	240,176	93.8

* Clinical patient encounters included those with stop code 323: primary care/medicine.

ACP: Associate Care Provider; CBOC: Community Based Outpatient Clinic; CNS: Clinical Nurse Specialist; FY: fiscal year; LPN: Licensed Practical Nurse; NA: Nursing Assistant; NP: Nurse Practitioner; PA: Physician Assistant; PCP: Primary Care Provider; RN: Registered Nurse; tech: technician; VAMC: Veterans Affairs Medical Center.

Table 6: Number and percentage of primary care encounters* among CBOC (n=609) and VAMC (n=155) primary care sites, by fiscal year.

	FY 2009		FY 2010		FY 2011		FY 2012		FY 2013	
Type of provider	n	%	n	%	n	%	n	%	n	%
Totals	11,731,188		11,693,793		11,521,914		11,283,082		11,177,709	
ACPs	3,352,654	28.6%	3,253,150	27.8%	3,529,230	30.6%	3,806,728	33.7%	3,934,480	35.2%
PCPs	8,378,534	71.4%	8,440,643	72.2%	7,992,684	69.4%	7,476,354	66.3%	7,243,229	64.8%
CBOC										
ACPs	**1,500,193**	**26.7%**	**1,521,160**	**26.5%**	**1,664,020**	**29.2%**	**1,788,377**	**31.9%**	**1,897,463**	**33.7%**
CNS	2,466	0.0%	1,548	0.0%	4,437	0.1%	2,786	0.1%	2,955	0.1%
RN	766,591	13.6%	780,157	13.6%	845,355	14.9%	922,659	16.5%	967,950	17.2%
LPN	550,266	9.8%	550,911	9.6%	621,686	10.9%	654,132	11.7%	704,964	12.5%
NA / tech	32,639	0.6%	25,368	0.4%	24,949	0.4%	26,243	0.5%	26,921	0.5%
Pharmacist / tech	109,523	2.0%	119,726	2.1%	119,165	2.1%	123,432	2.2%	136,754	2.4%
Social Worker	28,783	0.5%	32,772	0.6%	37,251	0.7%	42,982	0.8%	43,745	0.8%
Dietitian	5,367	0.1%	5,678	0.1%	6,557	0.1%	10,645	0.2%	9,782	0.2%
Behavioral Health	4,558	0.1%	5,000	0.1%	4,620	0.1%	5,498	0.1%	4,392	0.1%
PCPs	**4,120,802**	**73.3%**	**4,219,847**	**73.5%**	**4,027,908**	**70.8%**	**3,815,841**	**68.1%**	**3,731,421**	**66.3%**
Physician	3,019,423	53.7%	3,109,267	54.2%	2,944,605	51.8%	2,784,975	49.7%	2,734,437	48.6%
Resident	17,898	0.3%	12,233	0.2%	14,709	0.3%	9,111	0.2%	5,455	0.1%
NP	744,550	13.3%	781,275	13.6%	753,277	13.2%	720,162	12.9%	696,359	12.4%
PA	338,931	6.0%	317,072	5.5%	315,317	5.5%	301,593	5.4%	295,170	5.3%
VAMC										
ACPs	**1,852,461**	**30.2%**	**1,731,990**	**29.0%**	**1,865,210**	**31.9%**	**2,018,351**	**35.5%**	**2,037,017**	**36.7%**
CNS	10,967	0.2%	6,592	0.1%	5,778	0.1%	3,992	0.1%	2,850	0.1%
RN	917,066	15.0%	855,683	14.4%	951,275	16.3%	1,036,112	18.3%	1,028,313	18.5%
LPN	520,015	8.5%	479,372	8.1%	520,436	8.9%	565,226	10.0%	601,491	10.9%
NA / tech	19,781	0.3%	20,175	0.3%	19,633	0.3%	14,362	0.3%	15,157	0.3%
Pharmacist / tech	273,086	4.5%	258,835	4.4%	252,309	4.3%	263,295	4.6%	248,916	4.5%
Social Worker	81,352	1.3%	79,261	1.3%	83,351	1.4%	93,017	1.6%	100,755	1.8%

	FY 2009		FY 2010		FY 2011		FY 2012		FY 2013	
Type of provider	n	%	n	%	n	%	n	%	n	%
Dietitian	21,565	0.4%	23,667	0.4%	22,278	0.4%	28,724	0.5%	29,420	0.5%
Behavioral Health	8,629	0.1%	8,405	0.1%	10,150	0.2%	13,623	0.2%	10,115	0.2%
PCPs	**4,257,732**	**69.7%**	**4,220,796**	**70.9%**	**3,964,776**	**68.0%**	**3,660,513**	**64.5%**	**3,511,808**	**63.3%**
Physician	3,037,849	49.8%	3,043,412	51.2%	2,874,250	49.4%	2,676,934	47.2%	2,596,085	46.8%
Resident	141,892	2.3%	147,911	2.5%	134,017	2.3%	116,003	2.0%	106,843	1.9%
NP	721,608	11.8%	701,917	11.8%	658,557	11.3%	599,457	10.6%	568,708	10.3%
PA	356,383	5.8%	327,564	5.5%	297,952	5.1%	268,131	4.7%	240,176	4.3%

* Clinical patient encounters included those with stop code 323: primary care/medicine.

ACP: Associate Care Provider; CBOC: Community Based Outpatient Clinic; CNS: Clinical Nurse Specialist; FY: fiscal year; LPN: Licensed Practical Nurse; NA: Nursing Assistant; NP: Nurse Practitioner; PA: Physician Assistant; PCP: Primary Care Provider; RN: Registered Nurse; tech: technician; VAMC: Veterans Affairs Medical Center.

Table 7: Parameter estimates from the regression models* of the monthly rate of primary care encounters pre- and interim PACT for each type of provider in VHA primary care sites, FY 2009-FY 2013.

Provider	N of sites	N of observations (months)	β_{time}	RR_{time}	95% CI	$\beta_{time+time*PACT}$	$RR_{time+time*PACT}$	95% CI
ACP								
CNS	221	1,895	-0.066 †	0.936	(0.905, 0.968)	0.004	1.004	(0.956, 1.053)
RN	760	42,564	-0.038 †	0.963	(0.959, 0.967)	0.009 †	1.009	(1.003, 1.015)
RN‡	760	42,459	-0.020 †	0.980	(0.976, 0.984)	0.007 †	1.007	(1.000, 1.014)
LPN	750	40,222	-0.042 †	0.959	(0.954, 0.963)	0.009 †	1.009	(1.002, 1.017)
LPN‡	750	40,005	-0.023 †	0.977	(0.972, 0.982)	0.007 †	1.007	(1.000, 1.014)
NA / tech	444	8,752	-0.033 †	0.967	(0.956, 0.979)	0.005	1.005	(0.985, 1.024)
Pharmacist / tech	610	17,872	-0.003 †	0.997	(0.994, 1.000)	-	-	-
Social Worker	607	13,706	-0.003	0.997	(0.992, 1.003)	0.006 †	1.006	(1.000, 1.012)
Dietitian	294	4,209	0.005	1.005	(0.999, 1.012)	-	-	-
Behavioral Health	598	7,670	-0.001	1.000	(0.992, 1.007)	-	-	-
PCP								
Physician	761	44,358	-0.006 †	0.994	(0.994, 0.995)	-	-	-
Resident	490	8,025	-0.020 †	0.980	(0.973, 0.987)	-	-	-
NP	703	30,079	-0.007 †	0.993	(0.991, 0.994)	-	-	-
PA	513	15,952	-0.011 †	0.989	(0.987, 0.992)	-	-	-

* Negative binomial regression used to model the monthly rate of primary care encounters as the dependent variable. Analyses included a separate model for each provider. All models included the log of the number of patients in the site as offset, and were adjusted for time (in months), binary PACT indicator (0= pre-PACT period [Oct 2008-Mar 2010]; 1= interim PACT period [Apr 2010-Sept 2013]), interaction term for time*PACT, type of site (CBOC, VAMC), VHA geographic region, and percent of patients 65 years and older in the site. Estimates for the interim PACT trend (estimates of time + estimates for time*PACT) are provided for models that demonstrated a significant difference in trends pre- vs. interim PACT (i.e., significant time*PACT interaction).

† p-value <0.05

‡ Second model estimated after removal of all encounters with procedure codes indicating immunization administration.

ACP: Associate Care Provider; CBOC: Community Based Outpatient Clinic; CI: confidence interval; CNS: clinical nurse specialist; FY: fiscal year; LPN: licensed practical nurse; NA: nursing assistant; NP: nurse practitioner; PA: physician assistant; PACT: Patient Aligned Care Team; PCP: Primary Care Provider; RN: registered nurse; RR: rate ratio; SE: standard error; tech: technician; VAMC: Veterans Affairs Medical Center; VHA: Veterans Health Administration.

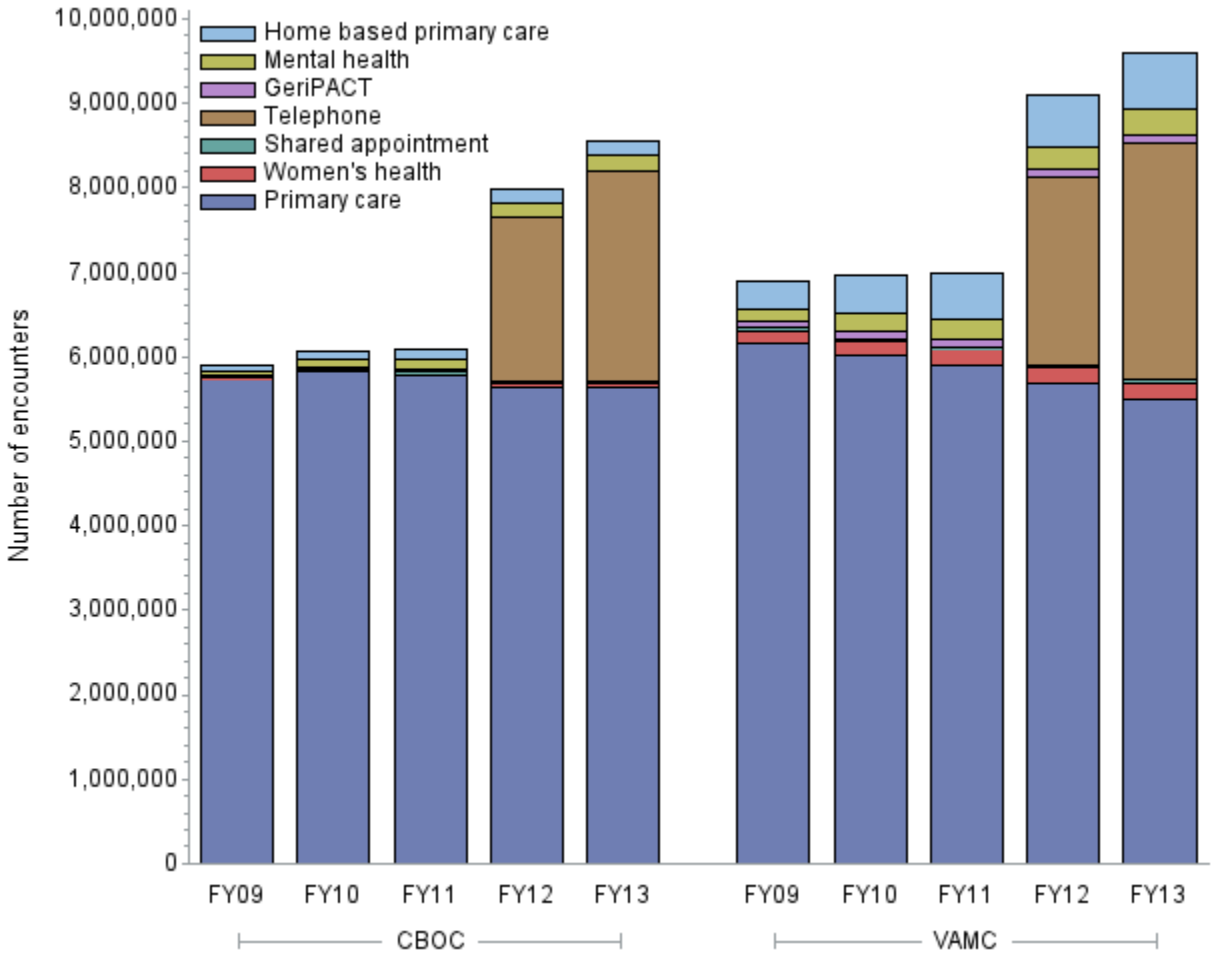


Figure 2: Number of primary care encounters by category and fiscal year among 609 CBOC and 155 VAMC sites.

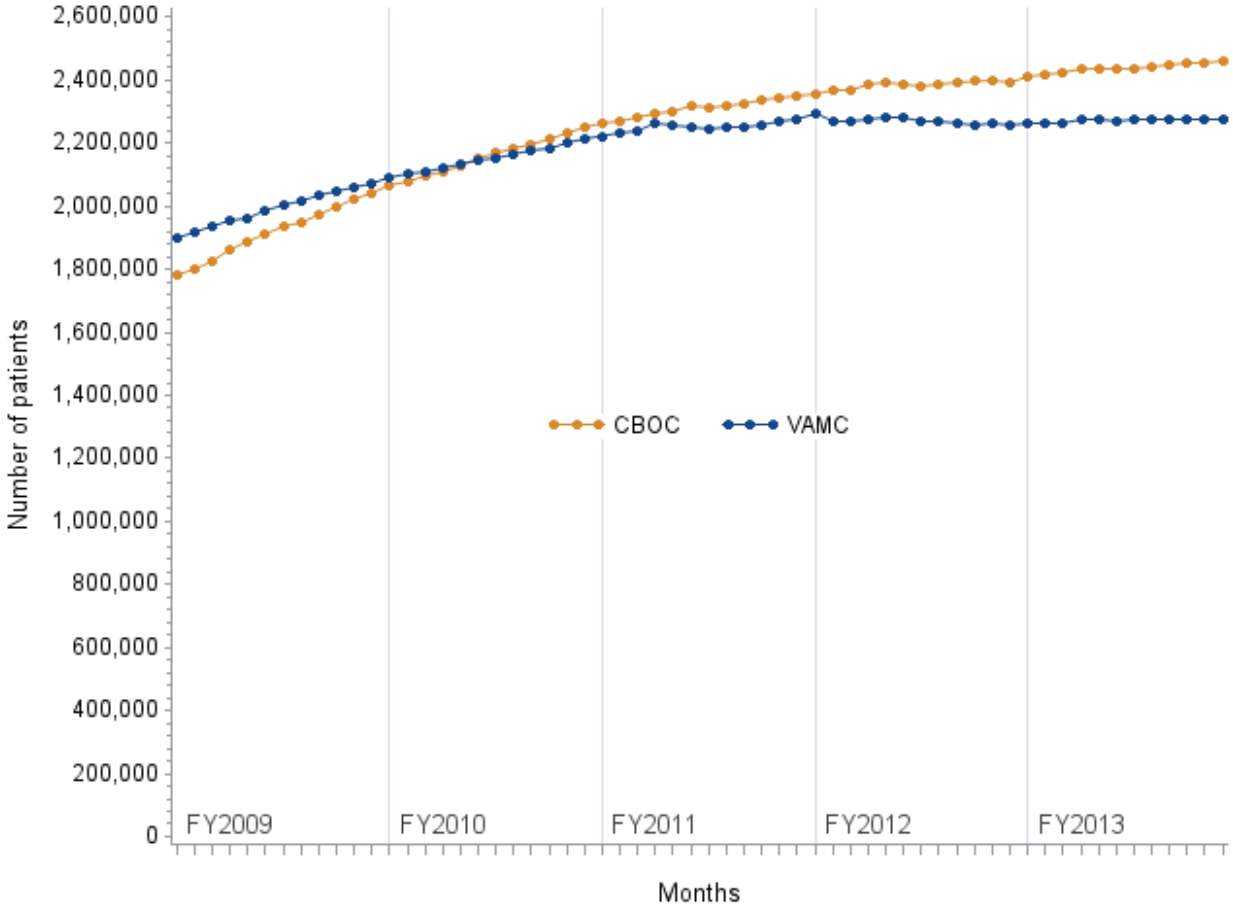


Figure 3: Monthly number of patients assigned to 609 CBOC and 155 VAMC primary care sites, FY2009-FY2013.

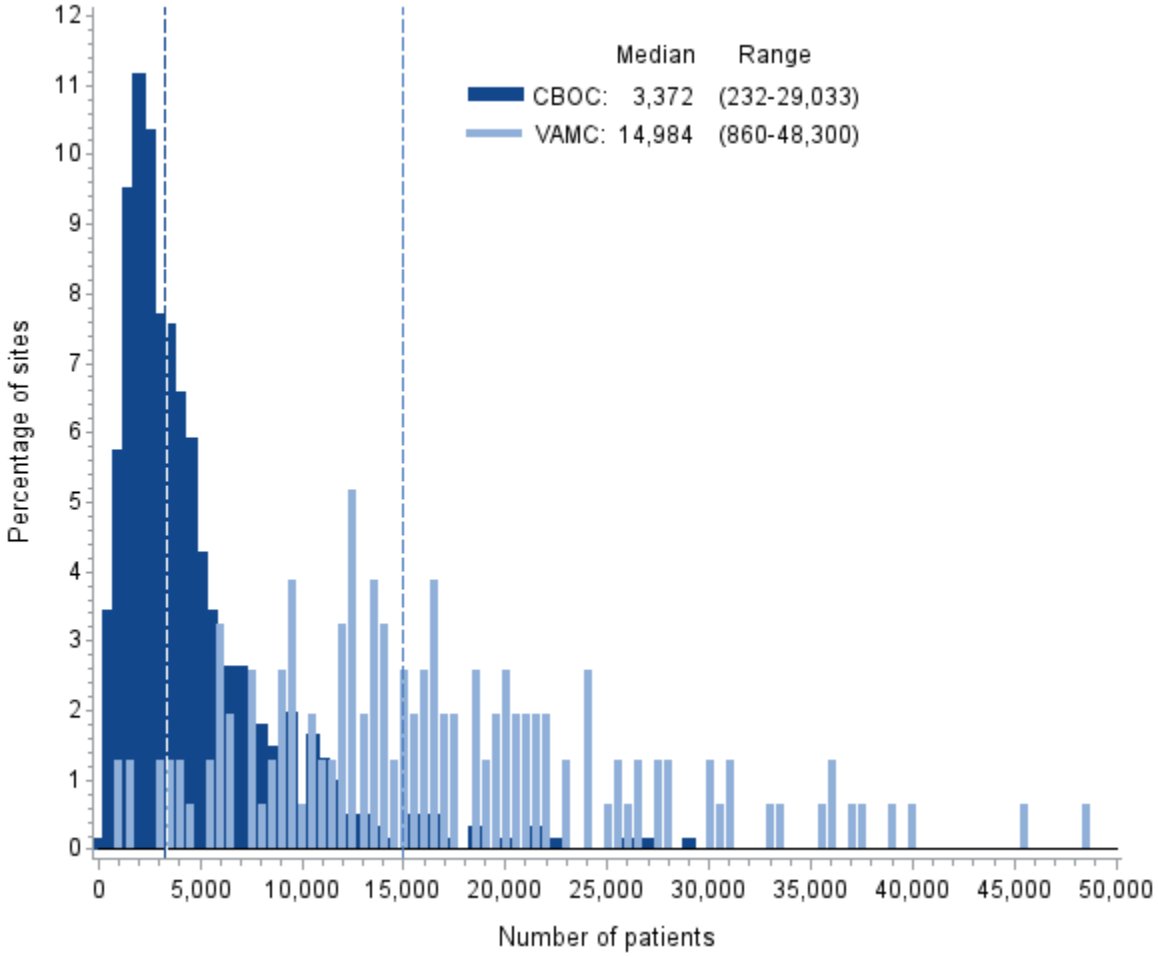


Figure 4: Distribution of the number of patients among 609 CBOC and 155 VAMC primary care sites, FY2013.

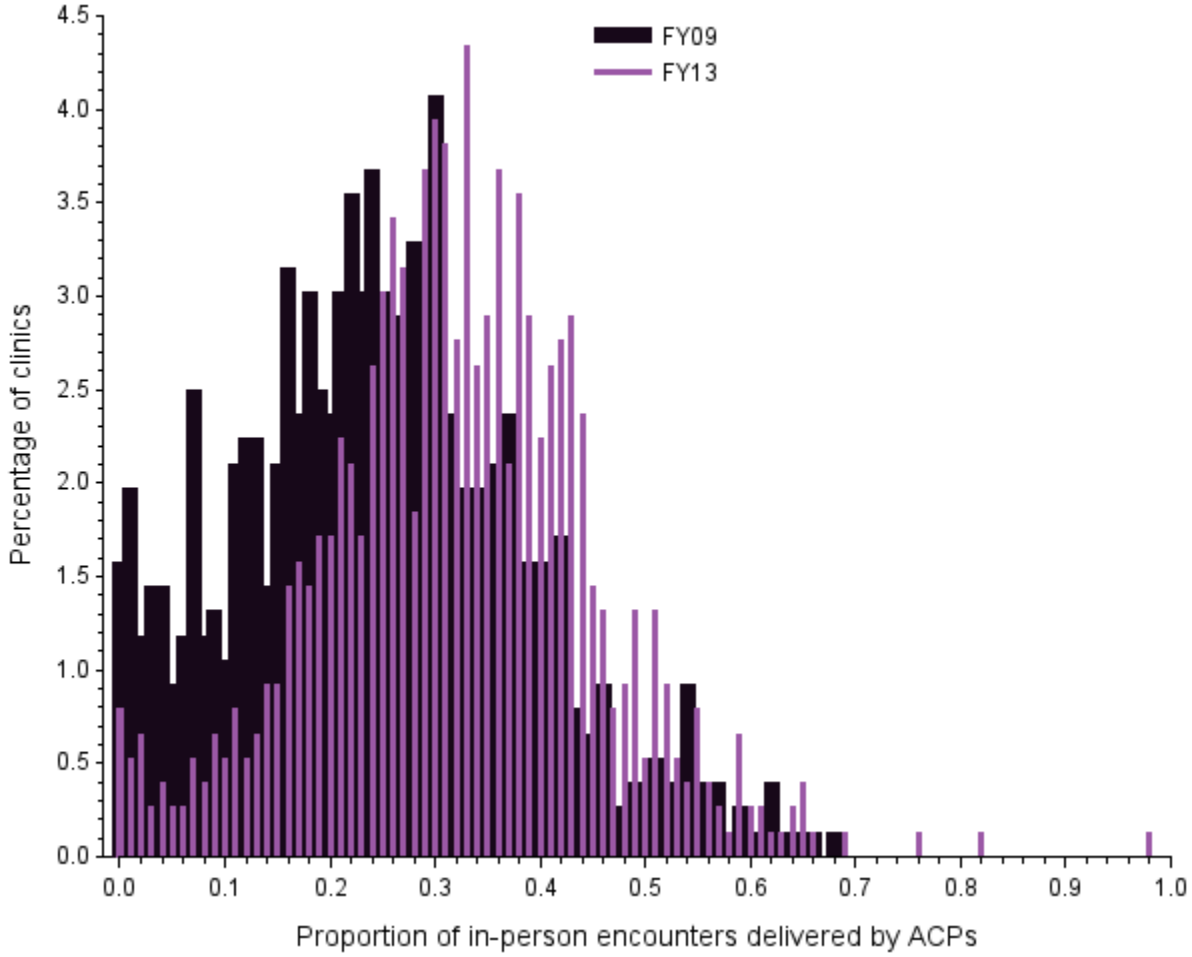


Figure 5: Distribution of the proportion of in-person primary care encounters delivered by ACPs among 609 CBOC and 155 VAMC primary care clinic sites, FY2009 compared to FY2013.

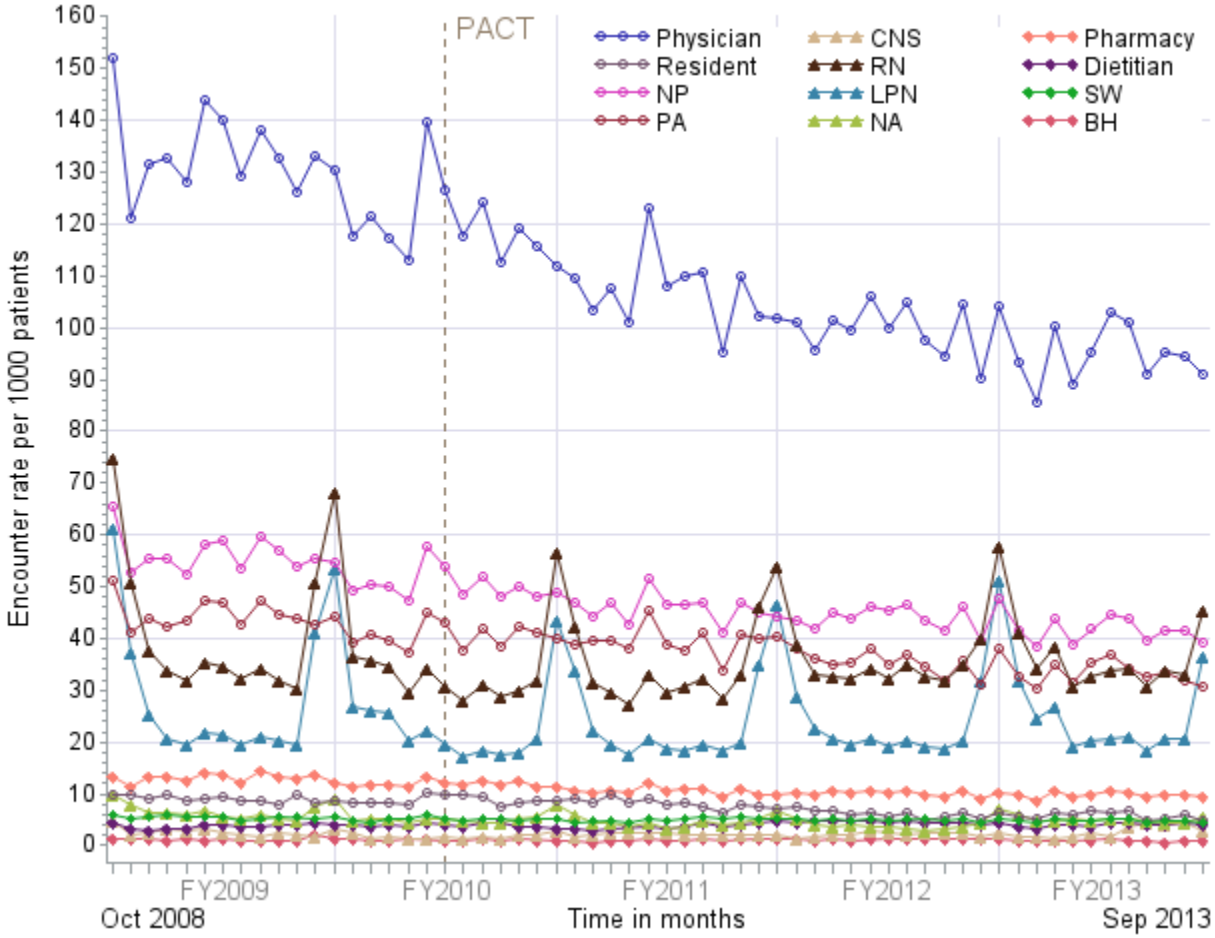


Figure 6: Unadjusted rates of in-person primary care encounters per 1000 patients by type of provider, FY2009-FY2013.

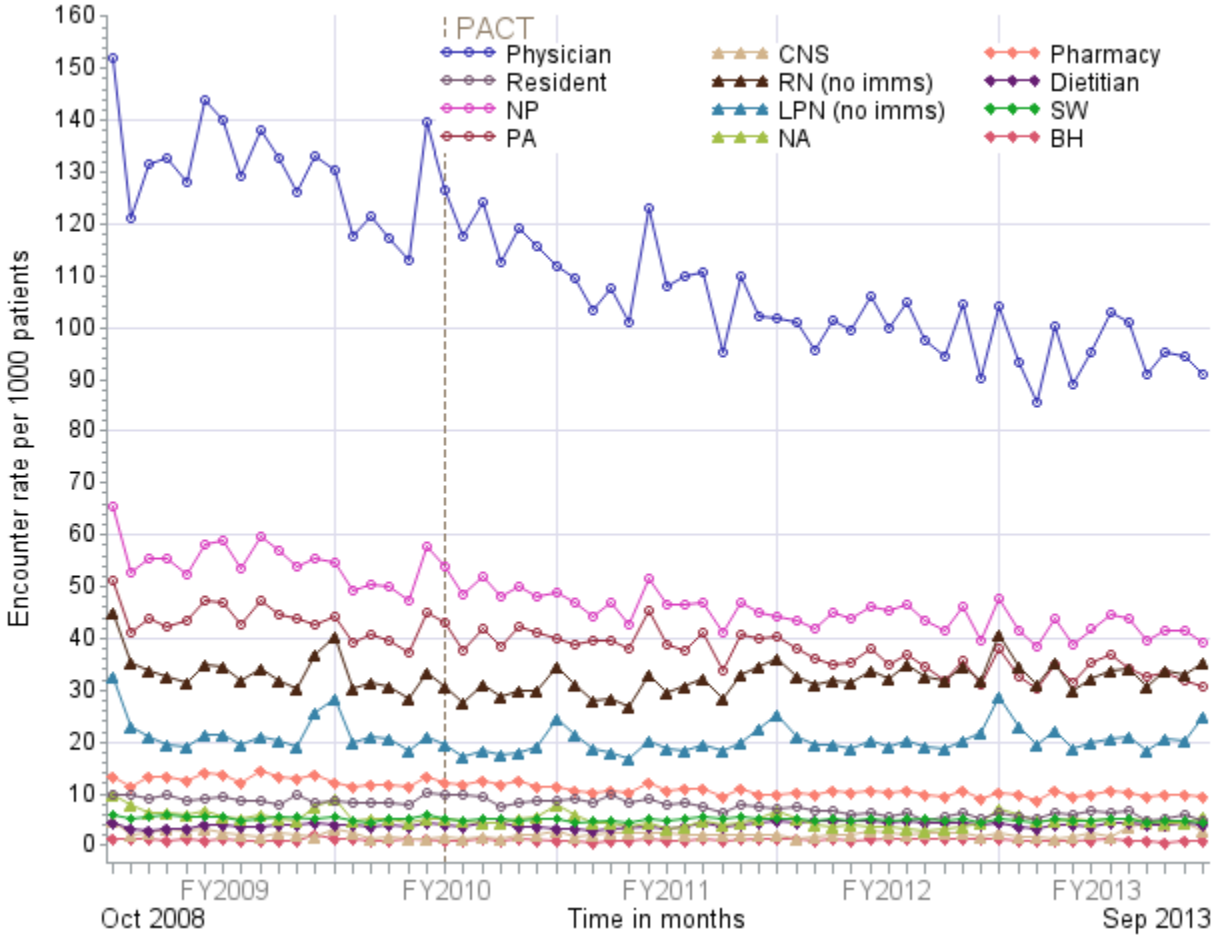


Figure 7: Unadjusted rates of in-person primary care encounters per 1000 patients by type of provider, excluding immunization encounters by RNs and LPNs, FY2009-FY2013.

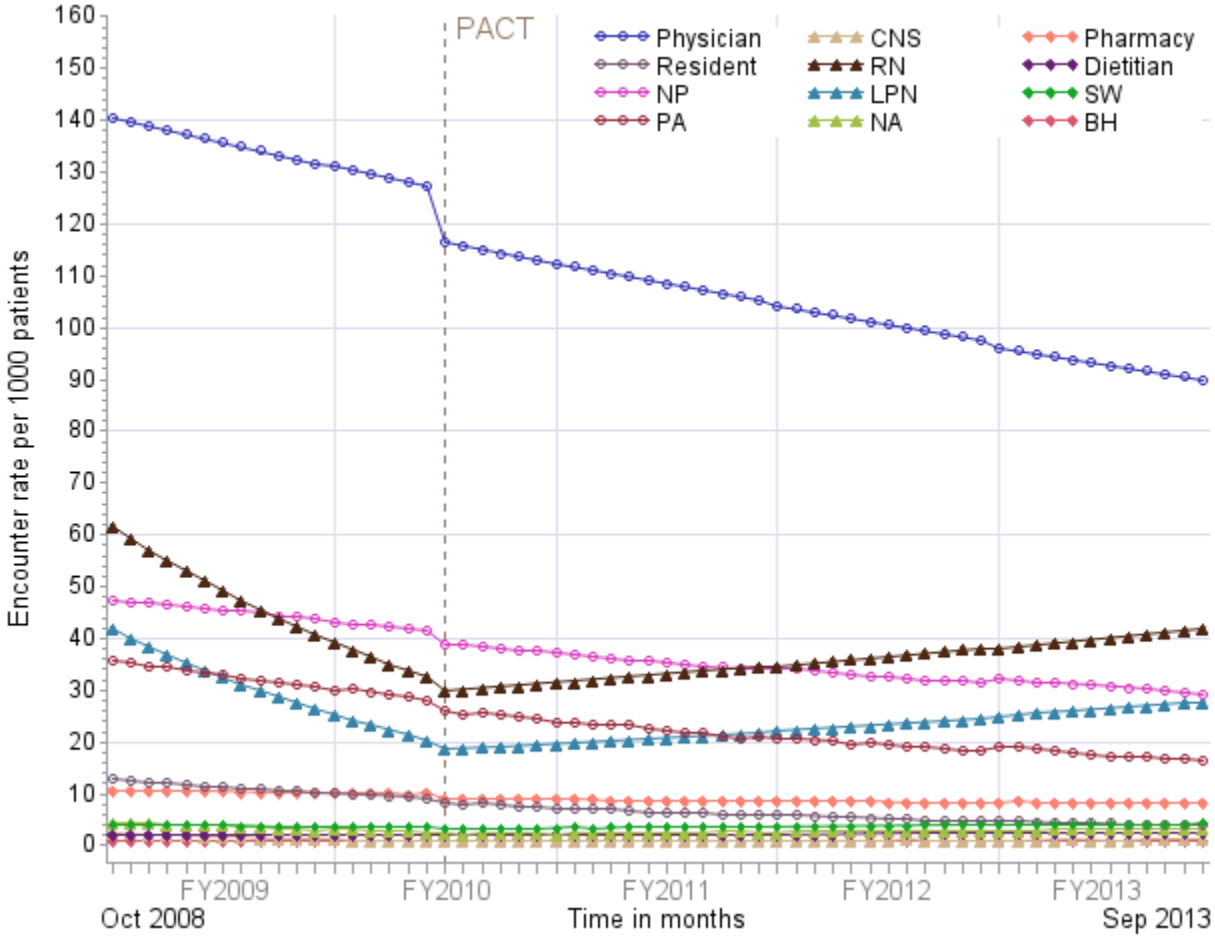


Figure 8: Adjusted predicted rates of in-person primary care encounters per 1000 patients by type of provider, FY2009-FY2013.

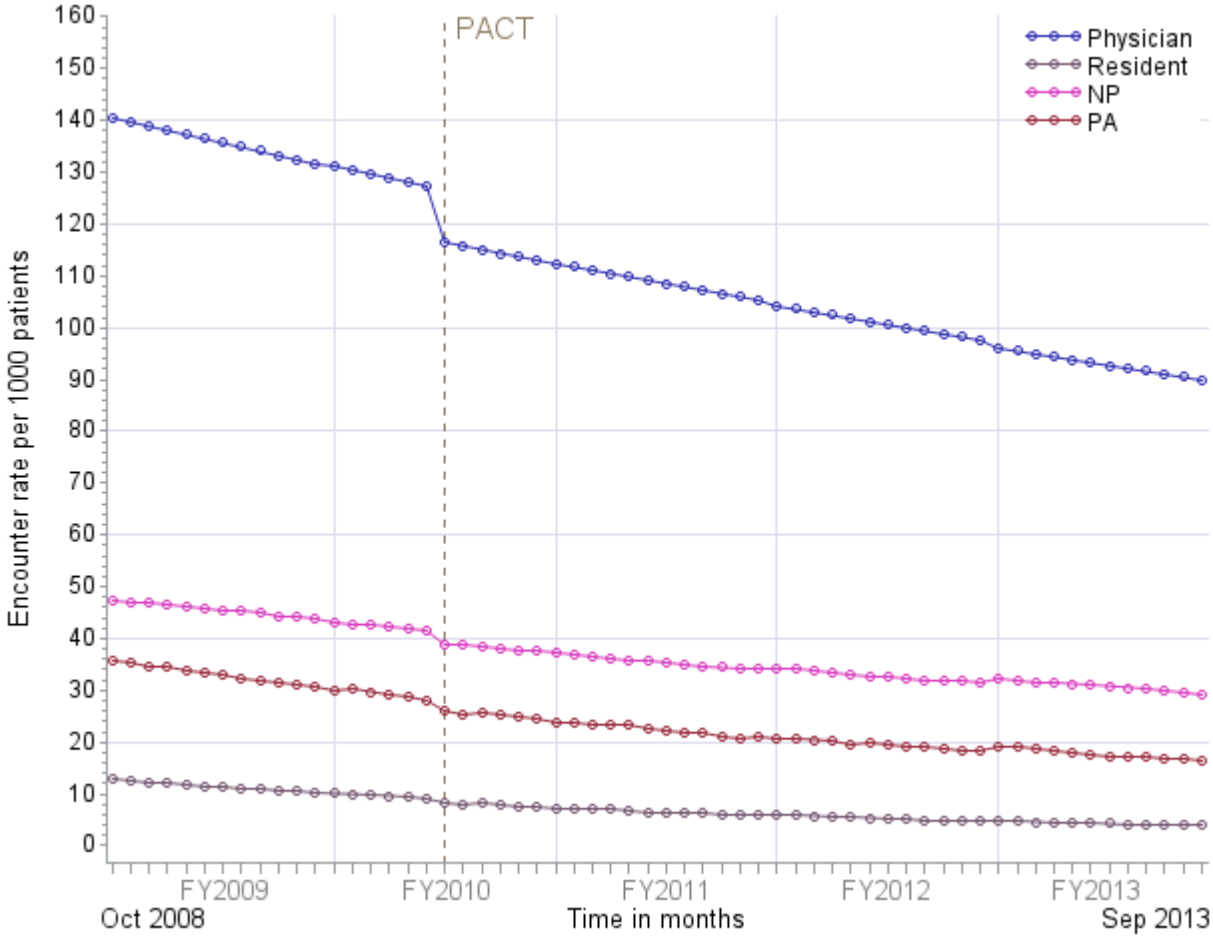


Figure 9: Adjusted predicted rates of in-person primary care encounters per 1000 patients by PCPs, FY2009-FY2013.

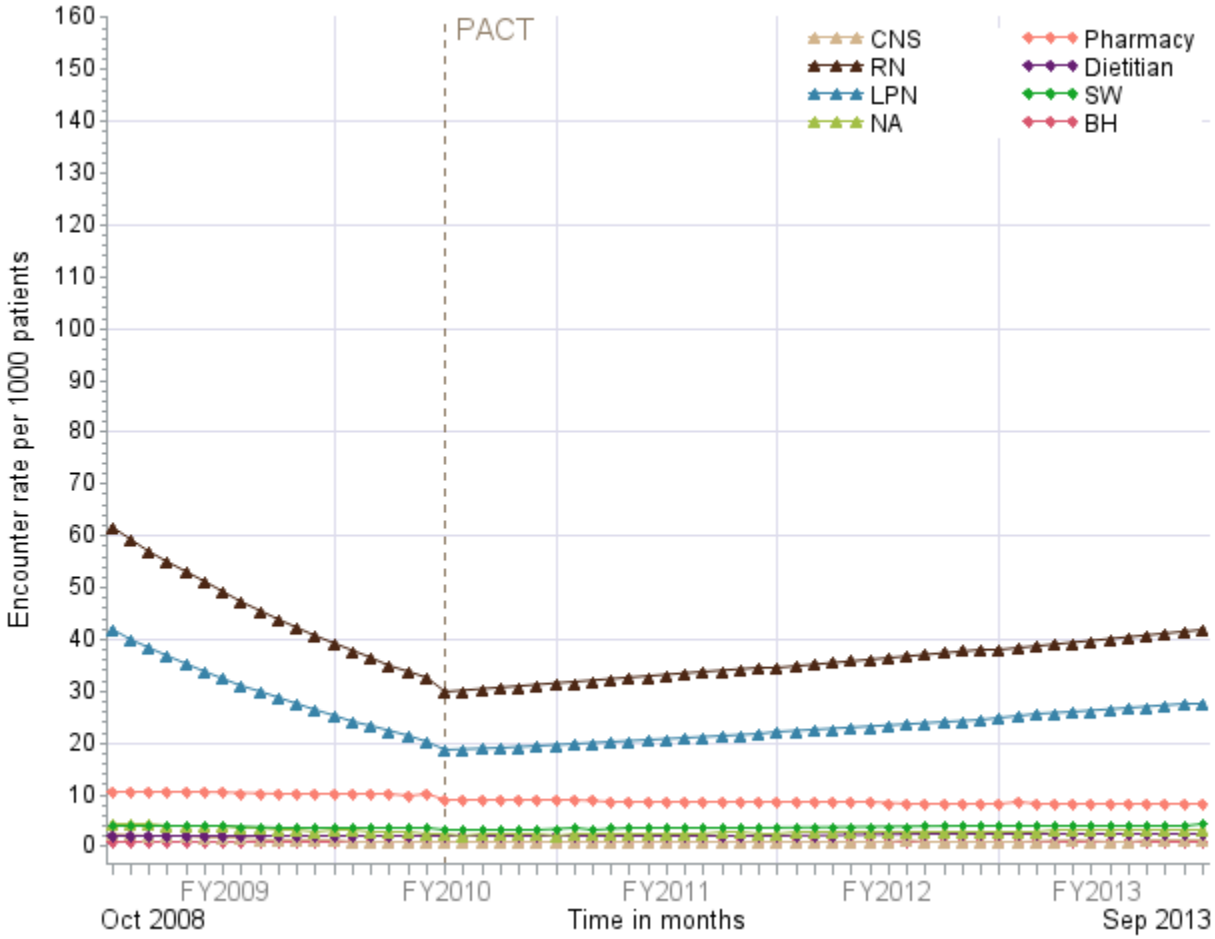


Figure 10: Adjusted predicted rates of in-person primary care encounters per 1000 patients by ACPs, FY2009-FY2013.

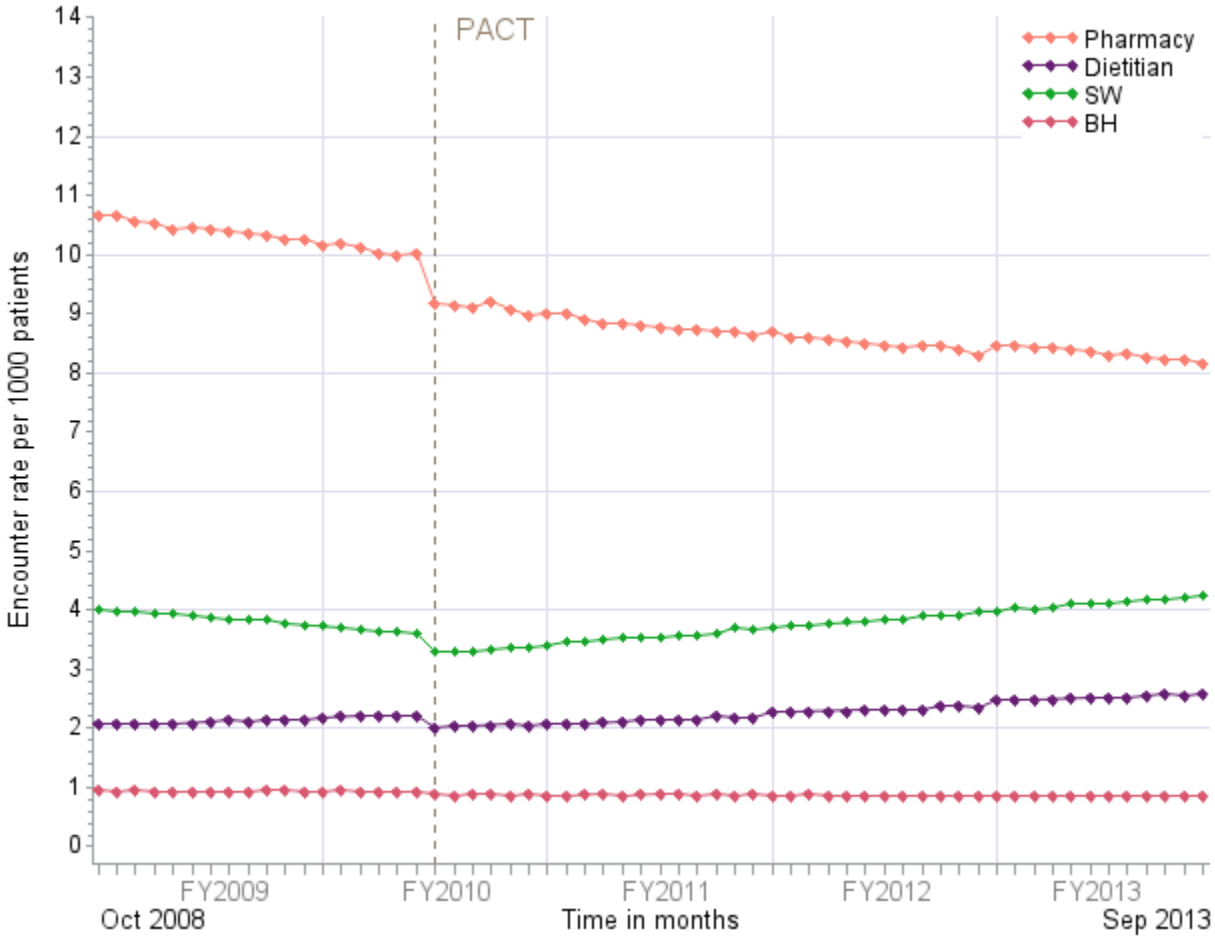


Figure 11: Adjusted predicted rates of in-person primary care encounters per 1000 patients by non-nursing ACPs, FY2009-FY2013.

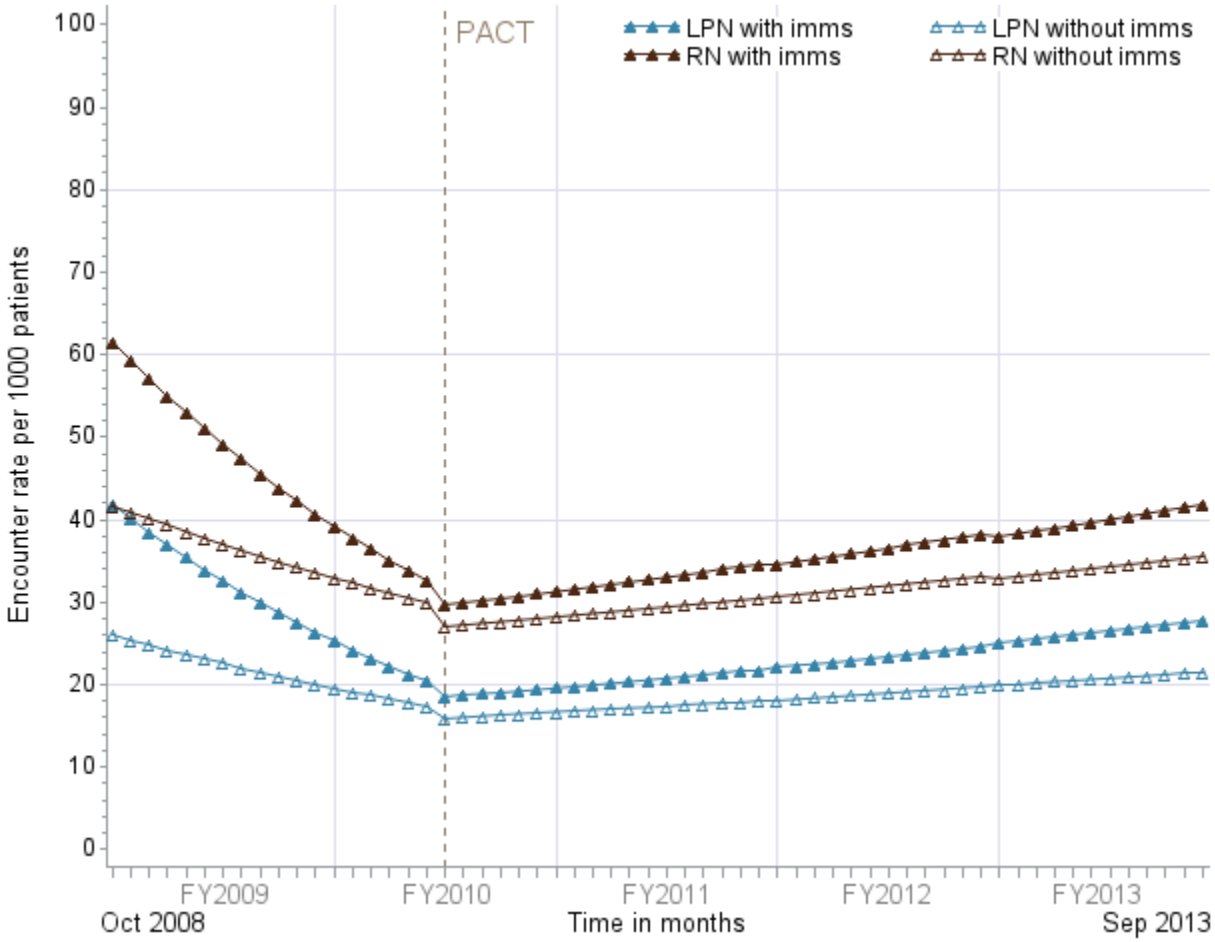


Figure 12: Adjusted predicted rates of in-person primary care encounters per 1000 patients, with and without immunizations, by RNs and LPNs, FY2009-FY2013.

CHAPTER IV: IMPACT OF CARE DELIVERY BY ASSOCIATE CARE PROVIDERS ON UTILIZATION

Introduction

The Patient Centered Medical Home (PCMH) is likely the most popular quality improvement initiative in primary care. The model has been highly promoted, culminating in the development and implementation of numerous programs across the nation (Bitton et al., 2010). PCMH transforms primary care by emphasizing core patient-centered values and key improvements to clinic processes to better deliver care to patients. Central to PCMH is the use of collaborative teams that coordinate care activities among team members and across health settings in order to provide comprehensive care. Transitioning from physician-centric clinical practice to team-based care is hypothesized to represent a more efficient and beneficial approach to care delivery (Altschuler, Margolius, Bodenheimer, & Grumbach, 2012; Calman et al., 2013).

Team-based care utilizes all team members to the full extent of their license and training (Solimeo et al., 2013). This includes the redistribution of workload from primary care providers (PCPs) to other members of the care team, such as nurses, pharmacists, and social workers. These members, herein called associate care providers (ACPs), are expected to assume a larger role in care delivery within the PCMH model. ACP team members can provide direct services during clinical encounters with patients, either

autonomously or with minimal intervention from PCPs (Bodenheimer & Smith, 2013). This includes providing treatment for acute minor illnesses, patient education and self-management support for chronic illness, medication teaching and reconciliation, post-hospital discharge follow-up care, arrangement of referrals, and coordination with other providers.

In recent years, there has been increased attention devoted to studying teams within the PCMH context. Researchers have examined the barriers to developing effective teams (Chesluk & Holmboe, 2010; Forman et al., 2014), the practice culture and mental models of teams (Cronholm et al., 2013), the development of team member roles (Findley, Matos, Hicks, Chang, & Reich, 2014), communication within teams (Fix et al., 2014), and competencies and training for teams (Leasure et al., 2013). Nonetheless, studies have not sufficiently quantified the care delivered by ACP team members, nor linked this care to the implementation of PCMH and associated outcomes. Rather, evaluations of PCMH tend to focus on the presence of specific functionalities in a clinic, and/or on the performance of PCPs. Although an important team-centered goal of PCMH is to increase the ability and involvement of ACPs to provide clinical care, it is not known whether implementation of the model is associated with increased ACP-delivered care. Furthermore, the lack of measurement of the effect of PCMH on ACPs has prevented an in-depth understanding of how PCMH, in conjunction with ACPs, impacts outcomes.

To evaluate the impact PCMH has on clinics, teams, and outcomes, it is essential to include measurement of ACP-delivered care. Thus, to further understand these dynamics in primary care delivery, this study specifically measured clinical patient

visits with ACPs to assess the relationships between ACP care, level of PCMH implementation, and outcomes. The underlying premises were that: 1) the extent of ACP involvement in patient encounters, in part, is indicative of care shared with PCPs, and therefore, represents a measureable aspect of team-based care, and 2) increased ACP involvement in patient encounters would have a beneficial impact on outcomes.

Theoretical Framework

PCMH and ACPs

Team-based care is "the provision of services to individuals, families, and/or their communities by at least two health providers who work collaboratively with patients and their caregivers…to accomplish shared goals" (Naylor et al., 2010). Central to the team-based philosophy is the active sharing of responsibilities among team members. In fact, effective interdisciplinary collaboration depends on the intensity with which teams share portions of care activities (Sicotte, D'Amour, & Moreault, 2002). Teams whose members cooperate in assigning tasks are aware of, and reflect on the unique skills of their members, which facilitates team functioning (True, Stewart, Lampman, Pelak, & Solimeo, 2014). Moreover, effective teams actively reallocate tasks to support members to work at the top of their abilities (True et al., 2014).

The drive for team-based care in PCMH has necessitated the redesign of provider roles. Namely, ACPs have assumed a greater role in clinical visits with patients, often in lieu of PCPs. Empowering team members with advanced roles can enhance collaboration (MacNaughton, Chreim, & Bourgeault, 2013). Thus, a shift in the distribution of care delivery among provider roles, as evidenced by increased ACP involvement in patient encounters, may reflect improved collaboration and shared care.

In fact, the utilization of ACPs to deliver care appears more prevalent among primary care settings with a high level of PCMH functioning, as compared to those at a lower level (Scholle et al., 2011). In one review, eleven of the twelve PCMH interventions studied were primarily delivered by non-physicians (Peikes, Zutshi, Genevro, Parchman, et al., 2012). And, underutilization of ACPs is considered a barrier to PCMH implementation (Nutting et al., 2012). ACP care delivery and team-based care are important mechanisms of quality primary care (Bodenheimer, Ghorob, et al., 2014).

PCMH and Outcomes

Among the most frequently measured outcomes in PCMH evaluations is health resource utilization—specifically, emergency department (ED) visits and inpatient hospitalization. These events are believed to be sensitive to the accessibility and receipt of quality primary care, and therefore, potentially preventable. They are readily available in administrative health system data, and they are associated with tangible costs—a high priority when assessing the effectiveness of an intervention. For these reasons, utilization metrics are recommended core outcome measures for PCMH evaluation programs (Rosenthal, 2012).

Several studies that have evaluated the impact of PCMH on utilization have shown beneficial effects. Among 2,708 uninsured, low-income California residents, both enrollment and length of enrollment in a PCMH were associated with fewer ED visits (Roby et al., 2010). In a large VA PCMH clinic with over 13,000 patients, continuity of care, which was considered an important goal of the PCMH model, was associated with a 46% reduction in ED utilization (Chaiyachati et al., 2014). Continuity of care has also been linked to reduced avoidable hospitalizations in a review of 49 studies (van Loenen

et al., 2014). A large health system's before and after evaluation of a PCMH demonstration found that patients enrolled in a PCMH had 29% fewer ED visits than patients in non-PCMH clinics (Reid et al., 2009). Similarly, a payer-founded PCMH initiative spanning several states demonstrated an 18% decrease in hospital admissions, in addition to a 15% decrease in ED visits (Raskas et al., 2012). Another study involving 11 PCMH intervention sites and 75 control sites found an 18% reduction in hospital admissions, and a 36% reduction in readmissions over a four year period (Gilfillan et al., 2010). It is evident that quality primary care and PCMH play a role in health resource utilization.

ACPs and Outcomes

Increasing patient access to health care is a high priority goal of PCMH programs. Care performed by ACPs, either as a substitution for or in conjunction with PCP intervention, helps meet patients' access needs by expanding the capacity of the clinic to provide services. Utilizing ACPs for tasks that do not necessitate PCP involvement can also free up PCP time for more complex patient needs. Access to primary care increases patients' likelihood of receiving recommended preventive and routine care, as well as management of chronic illness, all of which can reduce costly adverse health events, including ED visits and hospitalization.

The literature has reported some positive outcomes linked to ACP-delivered care. The integration of a nurse diabetes educator in a PCMH clinic site was associated with several improvements in clinical outcomes and was cost effective, although there was no significant reduction in emergency department visits or hospitalizations (Moran, Burson, Critchett, & Olla, 2011). A study of care teams consisting of a nurse care

manager, behavioral health specialist, social worker, and pharmacist, found that high-risk patients receiving care from a clinic with one of these teams had significantly reduced probability of hospitalization as compared to patients in clinics without such teams (Foltz et al., 2014). In a systematic review and meta-analysis of 26 studies, researchers found that nurse-led care was effective at decreasing risk of hospitalization and mortality (Martinez-Gonzalez et al., 2014).

In addition, medical home elements emphasizing ACP care and team-based care have been linked to improved outcomes (Day et al., 2013; Jaen et al., 2010; Maeng, Graf, Davis, Tomcavage, & Bloom, 2012; Moran et al., 2011; Solberg et al., 2011). One study found reduced hospitalizations and office visits associated with care delivered by a physician-nurse-social worker team as compared to physician-only care (Sommers et al., 2000). Care transitions post-hospitalization interventions by nurses have previously demonstrated a reduction in hospital readmissions (Kind et al., 2012). Pharmacist-delivered patient care has also been linked to several improved health outcomes, including reduced hospitalizations (Chisholm-Burns et al., 2010), decreased medication errors and adverse drug events (Murray, Ritchey, Wu, & Tu, 2009), and significant cost avoidance from prevented adverse patient outcomes (Hough, Vartan, Groppi, Reyes, & Beckey, 2013). Less is known about the effect of other ACPs in medical homes, although the advantages of having multiple skill sets from diverse disciplines, such as social work, have been promoted (Allen, 2012).

ACP Care as a Mediator

Although the previous studies discussed above have identified potential linkages between PCMH, ACP-delivered care, and outcomes, none have identified a conceptual

model of the relationship between all three. Furthermore, none have suggested ACP-delivered care as a mediator of the effect of PCMH on outcomes. A mediator effect of nurses' work engagement on the effect of quality of inpatient units on patient-centered care has previously been found (Abdelhadi & Drach-Zahavy, 2012). Since PCMH implementation requires providers to carry out the components involving patient care activities, the effect on outcomes is, at least, partly dependent on the work of providers, including how they allocate care tasks. Moreover, implementation of PCMH and improved access to care through expanded use of ACPs are expected to decrease health resource utilization as more patient care needs are addressed within primary care.

A conceptual model was developed based on the relationships between the level of PCMH implementation, ACP-delivered care, and utilization outcomes identified in the literature and described above (FIGURE 14). An important goal of PCMH is to foster team-based care, which includes increasing the involvement and autonomy of ACPs in care delivery. Therefore, the implementation of PCMH should result in an increase in ACP-delivered care. Thus, evidence of higher levels of involvement of ACPs to provide clinical care may indicate higher PCMH functioning at the clinic site, both of which may play a role in decreasing utilization.

PCMH in the Veterans Health Administration

In 2010, the Veterans Health Administration (VHA) introduced a version of the PCMH model, called Patient Aligned Care Teams (PACT), to all of its primary care sites (Klein, 2011). The implementation of PACT across the VHA health system was a long-term endeavor, involving considerable effort, leadership support, and the coordination of

a national PACT Collaborative to disseminate the model. Evaluations of PACT have been conducted and described extensively (Bidassie, Davies, Stark, & Boushon, 2014; Forman et al., 2014; Kansagara et al., 2014; Klein, 2011; LaVela et al., 2012; Luck et al., 2014; Rosland, Krein, et al., 2013; Rosland, Nelson, et al., 2013). As the largest integrated health care system in the U.S., and one of the largest national PCMH demonstrations, the VHA presented a unique opportunity to study ACP-delivered clinical services within the context of PCMH, and the impact on resource utilization outcomes.

Objectives

To examine ACP-delivered clinical care as an indicator of team-based care, a retrospective, cross-sectional study of primary care clinics within the VHA was conducted. This study aimed to: 1) test whether the involvement of ACPs in care delivery is a mediator of the effect of the level of PCMH implementation on health resource utilization, and 2) test whether the relationships between ACP-delivered encounters, level of PCMH implementation, and utilization varied from pre- to interim PACT implementation. These aims are based on the premise that the extent to which ACPs are involved in the delivery of encounters in primary care sites is an important mechanism of how PCMH improves outcomes. Thus, the effect of the level of PCMH implementation on utilization should be partially explained by ACP encounter delivery (i.e., partial mediator).

Methods

This study was reviewed and approved by the Veterans Affairs Ann Arbor Healthcare System and the University of Michigan Institutional Review Boards. The study included data from Veteran patients and their assigned VHA primary care clinic

sites nationally. Cross-sectional data were obtained for two 12-month time periods, corresponding to pre-PACT (April 1, 2009, to March 30, 2010) and interim PACT (April 1, 2011, to March 30, 2012) implementation. These time periods were selected specifically to encompass the two time points in which a PCMH survey was administered to VHA primary care sites (see *PCMH Components* below). The term 'interim' is used (rather than post) to connote that the implementation of PACT required considerable time and effort. Moreover, the initial start of PACT and level of implementation varied across sites, and was not considered 'complete' by 2012.

Study Population

VHA clinic sites were included when they had at least 500 total primary care encounters and at least 100 assigned patients during one of the two time periods. This included 760 sites in the pre-PACT period and 762 sites in the interim PACT period (FIGURE 13). VHA primary care sites are classified as Veterans Affairs Medical Centers (VAMCs) and Community Based Outpatient Clinics (CBOCs). A CBOC is a freestanding facility that is geographically located apart from a medical center.

Patients included Veterans aged 18 years and older. VHA employs a continuous assignment process whereby each Veteran is assigned to a single PCP. Since assignments can change over time, start and end dates are included in assignment records, which permitted the identification of monthly assignment for patients during the two time periods. To define a population of patients for each site that was sufficiently 'exposed' to primary care at the site, only patients with at least 10 months assignment to a particular site during a given 12-month period were included in the study.

Potential confounding variables accounted for in analyses included: the number of patients in a site, a binary flag indicating whether the site was a VAMC (1 if VAMC, 0 if CBOC), the percentage of patients in a site aged 65 years and older, and the percentage of patients in a site with a comorbidity score >2. The distribution of the number of patients among sites was skewed, and thus, log transformed. A comorbidity score for each patient was calculated by applying the Charlson comorbidity algorithm (Quan et al., 2005) to the diagnoses codes obtained from all outpatient and inpatient events that occurred during the corresponding time period. The Charlson comorbidity index consists of 17 illnesses or conditions defined by International Classification of Disease diagnosis codes, with clinically-relevant weights applied (Quan et al., 2005). This risk-based tool is commonly used with administrative data to measure illness burden in populations and to predict health outcomes, such as in-hospital mortality. The comorbidity algorithm has been updated and validated (Quan et al., 2011).

PCMH Components

Results from a PCMH survey of VHA primary care sites were obtained from the VHA Support Service Center, Clinical Program Support office. The Medical Home Builder Survey tool (currently called the ACP Practice Advisor) was developed by the American College of Physicians (ACP) in July 2009 to support medical practices in their efforts to improve their clinical and operational processes, including transition to a PCMH model of practice (ACP, 2015). This survey was administered to a clinic director or leader in all VHA primary care sites in October 2009 (pre-PACT), and again in July 2011 (interim PACT implementation). Complete survey data was available for 749 sites in pre-PACT period and 740 sites in the interim PACT period. Sites with missing data

were excluded (n=11 and 22, respectively). This survey tool ascertained the presence of 127 individual PCMH functionalities at the sites. Survey items are categorized into seven components, further described in (TABLE 8). Each individual item has a binary, yes/no, response. Scores are produced by calculating the proportion of yes responses (functionality present in site) reported for each component, expressed as a percentage (multiplied by 100). Thus, the component scores range from 0-100%, with 100% representing the highest level of implementation for a component. The ACP Medical Home Builder Survey results from VHA sites have previously been analyzed, with significant improvements noted between the two time points in which it was collected (Bidassie et al., 2014; Rosland, Nelson, et al., 2013).

Health Resource Utilization

Previous longitudinal analyses found that registered nurses (RNs) and licensed practical nurses (LPNs) had significant increases in the number of primary care encounters they provided to patients after the introduction of PCMH in VHA primary care sites (CHAPTER III: Trends in Care Delivery by Associate Care Providers). With the exception of social workers, PCMH implementation did not demonstrate a significant effect on encounter rates for other types of ACPs. The roles of other ACPs, such as pharmacists, in primary care delivery differ from those of nurses with respect to the type of care they provide and their presence and availability in clinic sites. RNs and LPNs represented the largest proportion of ACP-delivered care. Thus, as an initial step in further evaluating the relationship between PCMH implementation and ACP-delivered care, this study limited analyses to RN and LPN primary care encounters.

Therefore, the primary care utilization measure of interest was the rate of RN/LPN-delivered primary care encounters, which is a proxy for RN/LPN involvement in clinical care delivery. A primary care patient encounter is a professional contact between a patient and a provider (Department of Veterans Affairs, December 30, 2013). Encounters in VHA are documented using specific classification codes, which designate the type of care provided as well as the type of provider that was responsible for the encounter (Department of Veterans Affairs, May 29, 2013). All in-person primary care encounters with an RN/LPN recorded as the provider responsible for the care were obtained for the two time periods for the assigned patient population. Since the RN/LPN rate was the hypothesized mediator in the statistical models, primary care sites with no documented RN/LPN encounters were excluded (n=3 sites in pre-PACT and 2 sites in interim PACT periods).

The utilization outcome of interest analyzed in this study was all-cause, unscheduled, inpatient hospital admissions that occurred to any VHA facility during the two time periods for the study population. Although hospitalization for ambulatory care sensitive conditions is also commonly used to evaluate quality of care, some have questioned whether current methods by which to determine preventable admissions are sufficient (Longman, Passey, Ewald, Rix, & Morgan, 2015). Thus, as an initial assessment of a potential association between RN/LPN care delivery and hospitalization, this study did not limit analyses to hospitalizations for specific conditions or diagnoses. Some VHA clinic sites were found to have few documented hospitalizations for their patient populations, possibly due to one of the following: small patient population or clinic site with few patients, clinic site geographically located far

from a VHA facility with inpatient services, and/or patient use of non-VHA inpatient services. In order to ensure that the patient populations among sites had sufficient exposure or likelihood of having a hospitalization, only sites that had at least 36 hospitalizations for their patients in a time period were included (i.e., an average of three hospitalizations per month). A total of 688 sites in the pre-PACT period, and 684 sites in the interim PACT period met this criterion (FIGURE 13).

Rates of RN/LPN-delivered primary care encounters and inpatient hospitalization were calculated as the number of events during a 12-month period divided by the number of assigned patients in the period, multiplied by 1,000. Thus, these rates represented the annual number of events per 1,000 patients in a given year. Count data such as resource utilization is often skewed and non-normal, which was the case in this study. Both rates demonstrated non-normality and skewness to the right, and were log transformed to improve skewness and approximate a normal distribution.

Analyses

Descriptive statistics of variables were calculated. To develop and test for mediation, a structural equation modeling (SEM) approach was employed. SEM has advantages over the traditional causal steps approach for testing mediation, including the ability to simultaneously test multiple relationships among constructs and directly test mediator effects (Hayes, 2009). Furthermore, SEM allows simultaneous regression equations, whereby a variable can serve as both an independent and dependent variable, making it especially useful in testing mediation (Bowen & Guo, 2012). Recommendations from the literature for conducting SEM and reporting results were used to guide these analyses (Jackson, Gillaspy, & Purc-Stephenson, 2009; Kline,

2005; Lei & Wu, 2007; McDonald & Ho, 2002; Schreiber, 2008). Core elements of SEM described in detail herein include model specification, confirmatory factor analysis, model identification, sample size and power consideration, model estimation, evaluation, and modification. CFA and SEM were conducted with Stata Version 14 (StataCorp, College Station, TX).

The literature, as well as recent findings from a five-year longitudinal analyses of VHA primary care encounter data (see CHAPTER III), were used to inform directional paths in the model. Additionally, the correlations between variables further informed model development. Models were fit for both the pre-PACT and interim PACT periods to assess whether the relationships among variables had changed between time periods. Model diagnostics were examined and identified six clinic sites in the pre-PACT period and three sites in the interim PACT period that were influential outliers, and thus were excluded from the SEM models. The final number included in SEM analyses was 682 sites pre-PACT and 681 sites interim PACT.

The models were evaluated with several statistics. The overall fit of the CFA and SEM models was assessed with the overall model chi-square test statistic. The chi-square test statistic, which tests whether the model is an exact fit to the data (Weston, 2006), is the only true test of model fit (Barrett, 2007). The chi-square tests the discrepancy between the covariances for a hypothesized model and the covariances of the observed sample data (Barrett, 2007). The null hypothesis is that there is no difference. When the difference is larger than expected, the chi-square will be significant and the null will be rejected. Therefore, in the case of CFA and SEM, it is desirable to have a *non-significant* chi-square test, which indicates that there is no significant

difference between the model being tested and the observed data—i.e., the model "fits" the data. However, the limitation of the chi-square test is that as the sample size increases, the sensitivity of the test also increases, which raises the probability that the model will fail to fit the data (Barrett, 2007; Lei & Wu, 2007). In fact, among 41 SEM studies reviewed, McDonald & Ho (2002) found only five that reported a non-significant chi-square, most with fairly small sample sizes (n=70, 165, 193, 330, 461). Difficulty obtaining a non-significant chi-square often occurs when sample sizes are over 200 (Barrett, 2007). Given the fairly large sample size (n>680) in the current study, additional statistics recommended in the literature were used to supplement the chi-square test in assessing model fit.

Modification indices (MIs), which estimate how much the overall chi-square would be reduced given an additional parameter, were examined to further inform model development. Additionally, several goodness of fit statistics have been recommended as a means to evaluate the approximation of a model. The following tests and critical values by Hu and Bentler (1999) were used to indicate a good model: root mean squared error of approximation (RMSEA): ≤0.06; comparative fit index (CFI): ≥0.95; Tucker-Lewis index (TLI): ≥0.95; standardized root mean squared residual (SRMR): ≤0.08. Lastly, the Akaike's information criterion (AIC) and the Bayesian information criterion (BIC) were used to compare models, whereby a smaller value was desired.

Finally, alternative models were explored. The chi-square difference test was used to compare the full hypothesized model to three reduced, nested models to test whether certain linkages between the main variables of interest were supported. The

standardized and unstandardized coefficient estimates for a final proposed model is provided.

Results

Approximately 77% of the VHA primary care sites were CBOCs in each year (TABLE 9). The median number of patients among sites increased from 3,215 pre-PACT to 3,644 interim PACT. In total, there were 3,701,910 patients in the pre-PACT and 4,112,847 patients in the interim PACT period. The patient-level factors—percentage of patients 65 years and older, and the percentage of patient with a comorbidity score >2—remained stable over the two time periods.

The study patients had 2.5 million RN/LPN encounters in the pre-PACT period, and 2.7 million encounters in the interim PACT period. RNs delivered more primary care encounters than LPNs, and both experienced increases in the number of encounters they provided over time. The median rate of RN/LPN encounters among the primary care sites was similar: 593 encounters per 1,000 patients pre-PACT, and 574 encounters per 1,000 patients interim PACT. Both the population growth and the increase in the RN/LPN encounters are consistent with earlier findings (see CHAPTER III). There was a slight increase in the number of hospitalizations over time, with the median rate of hospitalizations consistent between time periods.

Lastly, there were noticeable improvements in the extent of PCMH implementation among the sites. Each of the Medical Home Builder component scores substantially increased between the two time periods, which has previously been described in more detail in the literature (Bidassie et al., 2014; Rosland, Nelson, et al., 2013).

Model specification

In selecting an appropriate measure of RN/LPN-delivered care, both the rate of RN/LPN encounters and the percentage of RN/LPN encounters out of total encounters in a site were considered. In fact, these were initially thought to reflect different aspects of RN/LPN involvement in care delivery: the rate representing the magnitude or extent of RN/LPN care, and the percentage representing the portion of RN/LPN care relative to PCPs. In this respect, they could be considered measured variables of a latent factor of RN/LPN involvement. However, these two indicators were found to be highly correlated (Spearman correlation coefficient= 0.9193, $p<0.0001$, interim PACT period). With few exceptions, the RN/LPN rate among sites mirrored the RN/LPN percentage (FIGURE 15). The presence of collinear measures modeled under a single latent factor, and modeled as individual observed factors, created problems with model estimation. Thus, only the RN/LPN rate of encounters was included in SEM analyses.

The RN/LPN rate was selected because unlike the RN/LPN percentage of encounters, it was not dependent on care delivered by PCPs. For example, as the percentage of encounters delivered by PCPs decreases, that of RN/LPNs must increase. Conversely, the rate of RN/LPN encounters was not correlated with the rate of PCP encounters (Spearman correlation coefficient= 0.0170, $p= 0.6575$, interim PACT period). And graphically, it did not appear that the PCP rate influenced the RN/LPN rate (FIGURE 16). Therefore, the RN/LPN rate appeared to measure a distinct aspect of primary care delivery, and did not merely reflect an inverse relationship with PCP encounter delivery.

Correlations among the variables were examined for the two time periods and are reported in TABLE 10 (pre-PACT) and TABLE 11 (interim PACT). Generally, the correlations were similar across years, and almost all were less than |0.6|, indicating no evidence of multicollinearity. As expected, all of the components of the Medical Home Builder Survey were significantly correlated with each other in each time period. The strongest correlations among the other variables were among the hospitalization rate and the site- and patient-level factors, such as number of patients in a site, VAMC designation, the percentage of patients 65 years and older, and the percentage of patients with comorbidity score >2. Interestingly, the percentage of patients 65 years and older was negatively correlated with the rates of RN/LPN encounters and hospitalizations each year. Since age 65 is the age of Medicare eligibility, it is likely that some patients with dual VHA and Medicare healthcare coverage utilize non-VHA outpatient and inpatient services, and thus their total utilization experience may be underrepresented here.

Based on the conceptual model described earlier, a model framework was developed, which included a measurement and a path model (FIGURE 17). The measurement model consisted of the seven components of the Medical Home Builder Survey, which together represented a primary care site's overall level of PCMH implementation—the latent factor PCMH. The specified path model consisted of the hypothesized path of mediation (bold arrows), which posits that the rate of RN/LPN encounters is a partial mediator of the effect of PCMH on the rate of hospitalizations.

Next, potential confounding factors were included as having direct effects on the three main variables of interest (straight, gray arrows). Previous studies have shown

that small primary care sites (typically measured as the number of PCPs) are disadvantaged in implementing PCMH and are less likely to utilize RN/LPNs as compared to larger sites (Nutting et al., 2012; Rittenhouse et al., 2011; Scholle et al., 2011). Since the number of PCPs per site was not available, the number of patients per site was used to represent the size of the clinic sites. A large number of patients was expected to correspond to higher PCMH scores and higher RN/LPN rates. Furthermore, a previous VHA study found that the number of primary care visits, as well as inpatient hospitalizations, among CBOC patients was significantly lower than that of VAMC patients (Maciejewski et al., 2007). Likewise, in longitudinal analyses of five years of VHA primary care data, RN/LPNs in VAMCs consistently had higher encounter rates than those in CBOCs (see CHAPTER III). Therefore, linkages between VAMC, number of patients, RN/LPN rate, the level of PCMH implementation, and hospitalization rate were supported.

An important patient-level factor that is associated with hospitalization is the illness burden of a clinic site's population. Approximately 72% of Veterans have at least one chronic illness (Yu et al., 2003). Elderly patients and those with chronic illness are more likely to experience adverse health events, including hospitalization. Moreover, these patients have complex health needs and are frequent utilizers of primary care services. Given the specialized care management support that RN/LPNs often provide, a high prevalence of these patients in a clinic site would likely increase the demand and need for RN/LPN care delivery. For example, RN care managers follow-up with patients after hospital discharge, coordinate services with specialists, and provide chronic illness education and self-management support to high-risk patients. Therefore, the percentage

of patients 65 years and older, and the percentage of patients with a comorbidity score >2 were included in the model, connected to both the RN/LPN encounter rate and the hospitalization rate.

Lastly, because CBOC primary care sites are physically located separate from medical centers, they tend to be smaller than VAMCs (median number of patients for CBOCs= 2,907, and for VAMCs= 11,740, interim PACT period). Thus, the CBOC/VAMC classification and the number of patients are related. In the current study, the percentage of patients with a comorbidity score >2 among CBOCs was about 13% for each year, whereas it was 17% among VAMCs each year. And, the percentage of patients 65 years and older tended to be higher among CBOCs (mean= 54% each year) as compared to VAMCs (mean= 46% each year). Due to the underlying, inherent relationships among these variables, the number of patients, VAMC indicator, the percentage of patients 65 years and older, and the percentage of patients with a comorbidity score >2 were allowed to covary with each other in the model (curved, gray arrows).

Alternative models

The hypothesized mediation model described above was designated Model 1. Alternative models consistent with the conceptual framework were also considered a priori (FIGURE 18). Three reduced models were developed by exploring whether certain pathways in the full model were justified, holding all other variables constant. For example, it was possible that the level of PCMH implementation may only have an indirect effect on hospitalizations, by influencing the RN/LPN rate (Model 2). Also likely was that the RN/LPN rate may not impact hospitalizations, but rather the level of PCMH implementation is an independent predictor of both (Model 3). Lastly, the level of PCMH

implementation and RN/LPN rate may potentially not be related and may be independent predictors of hospitalizations (Model 4).

Confirmatory factor analysis

As an initial step in SEM, a confirmatory factor analysis (CFA) was performed on the single latent factor, PCMH (representing the level of PCMH implementation), using maximum likelihood. Several PCMH components, as measured by the Medical Home Builder Survey, had items with similar or overlapping content. For example, several items in the access and scheduling component and the use of technology component measured slightly different aspects of the same concept, such as: the use of an electronic system to manage appointments and contact patients, the use of email communication, the use of electronic charting, and the tracking of referrals and test results. Because of the close relatedness of items across components, the decision to include covariances between components was guided by the content of the survey items, as well as an iterative process of examination of the MIs and the correlations between components.

The relationships among the components varied between the two time periods. A separate model for each time period was developed. The iterative addition of four covariances in the pre-PACT model and four in the interim PACT model substantially improved the model fit, per the goodness of fit indicators (TABLE 12). Both final models (Model E for pre-PACT, and Model E for interim PACT period) demonstrated non-significant (desirable) chi-squares, and had values for the RMSEA, CFI, TLI, and SRMR all within recommended limits. The added covariances were all significant at $p<0.05$, indicating these links were appropriate for inclusion. The factor loadings and

correlations of the final models are presented in (TABLE 13). Several of the factor loadings met the recommended value of >0.60 (Bollen, 1989), and all met the less stringent >0.40 recommendation (Acock, 2013). All components loaded significantly on the latent level of PCMH implementation factor at p<0.05. The correlations among the components were fairly good with no multicollinearity noted, and ranged from 0.164 to 0.536 pre-PACT, and from 0.277 to 0.553 interim PACT. All correlations were significant at p<0.05. Generally, the correlations were stronger in the interim PACT period than in the pre-PACT period, with a few exceptions.

Model identification

A model is identified when there is a unique estimate for all parameters (Schreiber, 2008). This requires that there are more free parameters than observed variables, or that the degrees of freedom (df) is greater than 0. Identification of the model is obtained by calculating the degrees of freedom (Weston, 2006). Using the interim PACT model, the number of known elements or correlations in the correlation matrix was calculated by:

$$\frac{k(k+1)}{2} = \frac{13(14)}{2} = 91\ known\ elements,$$

where k= the number of observed variables. Next, the number of parameters to be estimated is determined. The hypothesized model has:

$$6\ factor\ loadings\ (1\ is\ constrained) + 9\ error\ variances + 1\ disturbance +$$
$$12\ regression\ paths + 10\ covariances + 4\ variances\ of\ exogenous\ variables =$$
$$41\ parameters$$

Finally, the df was calculated by subtracting the unknown parameters from the known elements:

$$91 - 42 = 49\ degrees\ of\ freedom$$

Therefore, this model is considered overidentified, whereby the df>0, which means that estimation of the model is possible.

Sample size and power

SEM requires large sample sizes. Generally, it is recommended to have approximately 10-20 observations for each parameter estimated (Kline, 2005). For this study, this would equate to:

$$41 \times 10 = 410\ observations, and\ 41 \times 20 = 820\ observations.$$

The current study population of approximately 682 primary care sites was sufficient to conduct SEM (Fritz & Mackinnon, 2007). Additionally, with approximately 50 df, the minimum sample size required to achieve 80% power is 253 (MacCallum, 1996). A sample size of 500 with 50 df would yield an estimated power of over 99% (MacCallum, 1996). Therefore, the sample size of this study was considered adequate for SEM analyses.

Model estimation

The hypothesized mediation model (Model 1) was estimated for both years using maximum likelihood. Unstandardized and standardized estimates are reported in TABLE 14. During the pre-PACT period, the only path in the mediation pathway that was significant was a negative relationship between the level of PCMH implementation and the hospitalization rate (standardized β = -0.065, 95% confidence interval [CI] = -0.121, -0.010). The confounding (control) variables were also significantly related to the main variables of interest. For example, the percentage of patients 65 years and older, and the percentage of patients with a comorbidity score >2 were significantly related to both

the rates of RN/LPN encounters and hospitalizations. The site-level factors of VAMC and the number of patients in a site were associated with the RN/LPN encounter rate. Standardized estimates are included in the model diagram (FIGURE 19), with significant β estimates in bold.

Conversely, in the interim PACT period, the level of PCMH implementation had a significantly positive association with the RN/LPN rate (standardized β = 0.102, 95% CI= 0.019, 0.184), and the RN/LPN rate had a significantly negative relationship (standardized β = -0.057, 95% CI= -0.111, -0.002) with the hospitalization rate (TABLE 14). The level of PCMH implementation, though, did not have a direct effect on hospitalization rate. Thus, two of the three hypothesized mediation pathways were significant. Interpretation of the unstandardized estimates indicates that a one unit increase in the level of PCMH implementation was associated with an increase in the RN/LPN rate of approximately 2 encounters per 1000 patients per year ($e^{0.728} = 2.071\ encounters$). And a 30% increase in the RN/LPN rate would be associated with about a 2% decrease in the hospitalization rate ($1.30^{-0.057} = 0.98 = 2\%\ decrease$). Thus, a large increase in RN/LPN rate would be required for a small impact on hospitalization. The estimate for the indirect effect (data not shown) of the level of PCMH implementation on hospitalization rate via the RN/LPN rate was -0.028 (p= 0.017), indicating a small, but significant indirect effect, which further supports this two-step pathway.

Site- and patient-level factors were also significant in the interim PACT model. The VAMC classification of sites was associated with higher hospitalization rates as compared to CBOCs. Similar to the pattern seen in the correlations, an increase in the

percentage of patients 65 years and older was associated with significant decreases in the rates of RN/LPN encounters and hospitalizations. The percentage of patients with a comorbidity score >2, however, had the opposite effect and was associated with increased RN/LPN and hospitalization rates. The mediation model for the interim PACT period is displayed in FIGURE 20 with significant standardized β estimates in bold.

Model evaluation and modification

The three reduced, nested variations of the mediation model (FIGURE 18) were run for the interim PACT period. The SEM goodness of fit indicators were examined (TABLE 15). The chi-square statistics for all the models were significant, which indicates that there may be some misspecification in the hypothesized models, as the fit is not ideal. However, as mentioned previously, SEM with large sample sizes (>680 for this study) may cause the chi-square to be significant even when the model fits the data well (Schreiber, 2008; Weston, 2006). Therefore, additional goodness of fit tests were also assessed. The models had fairly good and similar test statistics, meeting the recommended values of RMSEA ≤0.06, CFI ≥0.95, and SRMR ≤0.08. The recommended TLI ≥0.95 was not met for the models. The AIC and BIC values across models were similar.

Overall, Models 1 and 2 were the most alike in terms of fit statistics, which was consistent with the path estimates from Model 1. The relationship between the level of PCMH implementation and hospitalization rate in Model 1 (the full model) was not significant. Thus, the removal of this path in Model 2 (the reduced model) did not appreciably change results. This was confirmed with a chi-square difference test. This chi-square tests for a difference between a full and nested model (Schreiber, 2008), and

is calculated by subtracting the overall chi-square value of the full model from that of the reduced model (Weston, 2006):

$$120.20 - 120.20 = 0, with\ 50 - 49 = 1\ df, yields\ p = 0.9597.$$

The non-significant p value indicates that there is no detectable difference between Model 1 and Model 2. Conversely, the chi-square difference test comparing Model 3 and Model 4 to Model 1 were significant (p= 0.042 and p= 0.016, respectively), which suggests that the paths from the level of PCMH implementation to RN/LPN rate and from RN/LPN rate to hospitalization rate are justified to leave in the model.

Discussion

This study explored the relationships between the level of PCMH implementation, the provision of primary care by RN/LPNs, and inpatient hospitalization. Several implications of this work are relevant. First, this analysis found that a higher level of implementation of PCMH components was significantly related to increased primary care encounter delivery by RN/LPNs among VHA primary care sites. This is consistent with previous research that has also found PCMH implementation to be associated with increased use of RN/LPNs to provide care (Scholle et al., 2013). Moreover, the relationship between the level of PCMH implementation and RN/LPN care was not present prior to PACT development in VHA. This suggests that PCMH implementation has, at least in part, influenced primary care delivery in clinic sites, and that this occurred relatively early on in the development of PACT in VHA (interim PACT period was within the first two years since the introduction of PACT).

Second, a significant, inverse relationship was found between RN/LPN care and hospitalization. To this author's knowledge, this is the first study that has linked clinical

patient encounters provided by RN/LPNs with a reduced rate of hospitalizations. However, it should be noted that this association was fairly weak (β coefficient= -0.057) and had modest significance (p= 0.042). In fact, the site- and patient-level factors were stronger predictors of hospitalization. The weak effect of RN/LPN-delivered encounters is potentially due to the influence of multiple other patient-related factors that impact the risk of hospitalization, which were unaccounted for in these analyses. Furthermore, hospitalization is a somewhat distal outcome, and thus, is more difficult to impact. Nonetheless, the connection between RN/LPN care and hospitalization warrants further investigation into the 'dose' effect and the nature of services provided during RN/LPN clinical encounters.

Third, the level of PCMH implementation had a direct effect on hospitalizations pre-PACT, but only an indirect effect on hospitalizations in the interim PACT period. Therefore, this study seems to suggest that the relationships between these three variables in the hypothesized mediation pathway changed with the introduction of PACT in VHA primary care sites. Prior to PACT, the extent to which clinic sites had PCMH-related components in use may have had an impact on the hospitalization rate of their patients. However, after the introduction of PACT, the implementation of PCMH components may have increased the involvement of RN/LPNs in care delivery, which in turn, appeared to have a role in impacting hospitalizations.

In post-hoc examination of these data, a mediation model was estimated for the rate of PCP encounters, which showed no significant relationship with the hospitalization rate. However, the level of PCMH implementation had a significant inverse association with the rate of PCP encounters (coefficient= -0.082, p= 0.038),

indicating that PCP encounters declined with the implementation of PCMH. This supports earlier findings of decreasing in-person encounter rates among PCPs after the introduction of PACT (see CHAPTER III), and may indicate a shift of workload from PCPs to RN/LPNs, and/or expanded roles for RN/LPNs, both of which are desired goals of team-based care.

Limitations

An important consideration in SEM is the presence of potential unknown alternative models that would better account for the observed data. There are likely additional factors that contribute to and/or are associated with the variables of interest that were not included. Since these data were cross-sectional, the true causal pathway between PCMH, RN/LPN-delivered care, and hospitalization cannot be unequivocally determined, and may be one that was not specified in this analysis. This would also include non-linear relationships. For example, there is likely a threshold at which increasing RN/LPN encounters reach their maximum effect on hospitalization, and the trajectory of this influence levels off and/or changes.

Because hospitalization is a somewhat distal outcome, the extent to which providers and clinic processes have a measureable impact is diminished. One literature review demonstrated that physicians, provider groups, and health plans generally explain only a small proportion of the total variation in performance measures, which include utilization, and that most variability is at a patient level (Fung et al., 2010). Moreover, the tangible impact of a program will be less when the measures are distal on the causal pathway (Wilson & MacDowell, 2003). Additionally, hospitalization is influenced by multiple patient- and system-level factors, many of which were not

accounted for in these analyses. All-cause hospitalizations may not be as sensitive to RN/LPN intervention as hospitalizations for ambulatory care sensitive conditions. Lastly, resource utilization that occurred outside the VHA system was unknown and not included. Thus, hospitalization events may have been undercounted, particularly among patients with access to non-VHA health services such as those aged 65 and older with Medicare benefits.

Conclusions

In summary, this study suggests that the implementation of PCMH is associated with increased RN/LPN activity, and that this is related to modestly lower hospitalization rates among patients in VHA primary care clinics. As PCMH continues to spread nationally, it is increasingly important to demonstrate its value, which includes its effect on team-based care and the roles of ACPs, such as RNs and LPNs, in care delivery. It is critical that PCMH programs encompass ACP-provided care in their evaluations for a more comprehensive assessment of this team-driven model.

Table 8: The seven components and number of items in the Medical Home Builder Survey.

Component		Items	Description
1	Patient-centered care and communication	19	Assess language/learning barriers; team member training in communication and cultural competency; self-management support; involve patients in decision-making.
2	Access and scheduling	9	Flexible scheduling: same day, open access, group visits, phone; non face-to-face clinical guidance.
3	Organization of practice	16	Organized office chart: problem list, medication list, progress notes; team functioning; test tracking; referral tracking.
4	Care coordination and transitions of care	18	Coordination with other clinicians; planned visits for patients with chronic conditions; assess progress on care plans and barriers; send/receive care transitions information; transitions communication; patient-physician assignment.
5	Use of technology	37	Management/billing system includes important data; use of e-prescribing; e-prescribing decision support; electronic health record; web-based personal health record; electronic system to manage/track tests; email communication with patients; website for patient contact with practice; identification of patients in need.
6	Population management	13	Monitor frequent diagnoses seen and common risk factors; generate lists of patients in need of services; incorporate evidence-based guidelines; use of practice guidelines for preventive services.
7	Quality and performance improvement	15	Measure/receive practice performance data; produce reports on clinical performance measures; collect data from patients/families about care experience; set goals of improved performance; report performance results externally.

Table 9: Characteristics of the primary care sites* included in the study, by time period†.

Characteristic	Pre-PACT	Interim PACT
Type of site, total n	***688***	***684***
CBOC, n	534	529
VAMC, n	154	155
Total unique patients, n	3,701,910	4,112,847
Number of patients in site, median (range)	3,215 (366-35,210)	3,644 (159-36,756)
Percentage of patients 65 and older, mean (range)	51.9% (11.0%)	52.2% (10.8%)
Percentage of patients with Charlson comorbidity score >2, mean (sd)	14.6 (4.0)	14.3 (4.1)
Utilization		
Total RN/LPN-delivered encounters, n	***2,516,683***	***2,738,206***
Total RN-delivered encounters, n	1,532,940	1,666,514
Total LPN-delivered encounters, n	983,743	1,071,692
Rate of RN/LPN-delivered encounters‡ per 1,000 patients, median (range)	593 (3-4,579)	574 (1-3,967)
Total inpatient hospitalizations, n	445,527	476,284
Rate of inpatient hospitalizations per 1,000 patients, median (range)	69 (14-400)	69 (13-371)
Medical Home Builder component scores, mean (sd)		
1: Patient-centered care	57.1% (18.7)	70.8% (18.8)
2: Access and scheduling	66.3% (14.4)	78.7% (17.2)
3: Organization of practice	72.3% (14.7)	82.6% (13.2)
4: Care coordination	67.9% (20.6)	80.2% (16.9)
5: Use of technology	67.5% (8.3)	77.8% (11.3)
6: Population management	75.8% (20.6)	85.1% (17.7)
7: Quality and performance	86.3% (17.0)	91.1% (13.9)

* Primary care sites included CBOCs or VAMCs with at least 100 unique Veteran patients, at least 500 total primary care encounters in a given year, documented RN or LPN encounters, and at least 36 hospitalizations for their populations.

† The Medical Home Builder Survey was administered in October 2009 (pre-PACT) and July 2011 (PACT). For all other characteristics, time periods consisted of 12 months. Pre-PACT period was from April 1, 2009, to March 30, 2010. Interim PACT period was from April 1, 2011, to March 30, 2012.

‡ Encounters included in-person primary care encounters with RNs or LPNs.

CBOC: Community Based Outpatient Clinic; LPN: licensed practical nurse; PACT: Patient Aligned Care Team; RN: registered nurse; sd: standard deviation; VAMC: Veterans Affairs Medical Center.

Table 10: Spearman's correlations of variables, pre-PACT period* (n=682 primary care sites).

Variable†	MHB1	MHB2	MHB3	MHB4	MHB5	MHB6	MHB7	RN/LPN	Hosp	N pat	Age 65	Comorb
MHB1	1											
MHB2	**0.308**	1										
MHB3	**0.297**	**0.401**	1									
MHB4	**0.465**	**0.316**	**0.531**	1								
MHB5	**0.341**	**0.159**	**0.109**	**0.264**	1							
MHB6	**0.468**	**0.313**	**0.509**	**0.509**	**0.280**	1						
MHB7	**0.324**	**0.290**	**0.398**	**0.380**	**0.141**	**0.551**	1					
RN/LPN rate	**-0.085**	-0.023	0.008	-0.031	0.009	0.051	-0.031	1				
Hosp. rate	-0.026	**-0.083**	**-0.084**	**-0.120**	-0.070	-0.061	0.006	**0.087**	1			
No. patients	0.053	**0.151**	-0.030	-0.053	-0.016	0.025	0.046	0.007	**0.303**	1		
Age 65+	-0.048	**0.076**	0.020	0.025	0.008	**-0.095**	-0.035	**-0.149**	**-0.419**	**-0.335**	1	
Comorbidity	**-0.075**	0.020	-0.023	-0.063	-0.002	-0.027	0.007	**0.185**	**0.446**	**0.219**	**-0.043**	1
VAMC	0.016	0.058	**-0.077**	-0.035	-0.047	-0.028	0.002	0.061	**0.596**	**0.618**	**-0.334**	**0.404**

* The MHB Survey was administered in October 2009. For all other variables, pre-PACT period was from April 1, 2009, to March 30, 2010.

† Variables were defined as follows: MHB1-MHB7: seven component scores of the MHB, each ranging from 0-1, with 1 representing highest level of implementation. RN/LPN, hospitalization rates calculated as: (number of events / number of patients)*1000. Number of patients: count of unique Veterans aged 18 years and older who were assigned to a VHA primary care site for at least 10 months during period. Age 65 and older: percentage of patients in a primary care site who were aged 65 years or older. Comorbidity: percentage of patients in a primary care site with a Charlson comorbidity score >2. VAMC: 1 if VAMC, 0 if CBOC primary care site.

Correlations with significant p-value < 0.05 are in **bold**.

CBOC: Community Based Outpatient Clinic; LPN: licensed practical nurse; MHB: Medical Home Builder Survey; RN: registered nurse; PACT: Patient Aligned Care Team; VAMC: Veterans Affairs Medical Center; VHA: Veterans Health Administration.

Table 11: Spearman's correlations of variables, interim PACT period* (n=681 primary care sites).

Variable†	MHB1	MHB2	MHB3	MHB4	MHB5	MHB6	MHB7	RN/LPN	Hosp	N pat	Age 65	Comorb
MHB1	1											
MHB2	**0.381**	1										
MHB3	**0.575**	**0.389**	1									
MHB4	**0.448**	**0.371**	**0.538**	1								
MHB5	**0.452**	**0.506**	**0.439**	**0.353**	1							
MHB6	**0.415**	**0.324**	**0.406**	**0.335**	**0.326**	1						
MHB7	**0.252**	**0.230**	**0.315**	**0.299**	**0.262**	**0.335**	1					
RN/LPN rate	0.012	0.006	-0.025	0.020	0.015	0.059	0.030	1				
Hosp. rate	-0.006	0.032	-0.016	**-0.102**	0.021	0.053	0.014	0.038	1			
No. patients	**0.085**	**0.168**	0.009	-0.014	0.030	0.065	-0.012	-0.001	**0.289**	1		
Age 65+	-0.027	-0.006	0.051	**0.076**	-0.043	**-0.094**	-0.033	**-0.085**	**-0.339**	**-0.383**	1	
Comorbidity	0.024	0.031	-0.008	0.005	**-0.081**	-0.006	0.034	**0.144**	**0.419**	**0.175**	**0.081**	1
VAMC	0.027	0.069	-0.042	-0.034	0.029	-0.002	-0.022	0.051	**0.590**	**0.595**	**-0.315**	**0.401**

* The MHB Survey was administered in July 2011. For all other variables, interim PACT period was from April 1, 2011, to March 30, 2012.

† Variables were defined as follows: MHB1-MHB7: seven component scores of the MHB, each ranging from 0-1, with 1 representing highest level of implementation. RN/LPN, hospitalization rates calculated as: (number of events / number of patients)*1000. Number of patients: count of unique Veterans aged 18 years and older who were assigned to a VHA primary care site for at least 10 months during period. Age 65 and older: percentage of patients in a primary care site who were aged 65 years or older. Comorbidity: percentage of patients in a primary care site with a Charlson comorbidity score >2. VAMC: 1 if VAMC, 0 if CBOC primary care site.

Correlations with significant p-value < 0.05 are in **bold**.

CBOC: Community Based Outpatient Clinic; LPN: licensed practical nurse; MHB: Medical Home Builder Survey; RN: registered nurse; PACT: Patient Aligned Care Team; VAMC: Veterans Affairs Medical Center; VHA: Veterans Health Administration.

Table 12: Goodness of fit indicators from confirmatory factor analysis of the seven PCMH components of the Medical Home Builder Survey.

Model	Likelihood ratio χ^2	df	p-value	RMSEA	CFI	TLI	SRMR	CD	AIC	BIC
Pre-PACT*										
Model A: components 1-7	106.96	14	<0.0001	0.099	0.027	0.891	0.041	0.831	-5283	-5188
Model B: model A plus cov(1, 3)	81.60	13	<0.0001	0.088	0.946	0.913	0.037	0.850	-5307	-5207
Model C: model B plus cov(6, 7)	49.49	12	<0.0001	0.068	0.971	0.949	0.031	0.854	-5337	-5233
Model D: model C plus cov(3, 5)	22.41	11	0.021	0.039	0.991	0.983	0.020	0.880	-5362	-5253
Model E: model D plus cov(4, 7)	16.90	10	0.077	0.032	0.995	0.989	0.017	0.889	-5365	-5252
Interim PACT*										
Model A: components 1-7	85.13	14	<0.0001	0.086	0.950	0.925	0.036	0.838	-5631	-5536
Model B: model A plus cov(2, 5)	46.60	13	<0.0001	0.062	0.976	0.962	0.026	0.830	-5668	-5568
Model C: model B plus cov(6, 7)	32.57	12	0.001	0.050	0.985	0.975	0.021	0.827	-5680	-5576
Model D: model C plus cov(1, 6)	22.65	11	0.020	0.039	0.992	0.984	0.018	0.819	-5688	-5579
Model E: model D plus cov(1, 5)	14.44	10	0.154	0.026	0.997	0.993	0.015	0.814	-5694	-5581

* The Medical Home Builder Survey was administered in October 2009 (pre-PACT, n=682) and July 2011 (interim PACT, n=681).

AIC: Akaike's information criterion; BIC: Bayesian information criterion; CD: coefficient of determination; CFI: comparative fit index; cov: covariance; df: degrees of freedom; PACT: Patient Aligned Care Team; PCMH: Patient Centered Medical Home; RMSEA: root mean squared error of approximation; SRMR: standardized root mean squared residual; TLI: Tucker-Lewis index.

Table 13: Standardized factor loadings and Pearson's correlations from the final confirmatory factor analysis models of the seven PCMH components of the Medical Home Builder Survey.

PCMH components	Factor loadings	SE	Correlations					
			1	2	3	4	5	6
Pre-PACT*								
1: Patient-centered care	0.692	0.029	1					
2: Access and scheduling	0.499	0.031	0.335	1				
3: Organization of practice	0.782	0.026	0.327	0.413	1			
4: Care coordination	0.682	0.025	0.469	0.307	0.536	1		
5: Use of technology	0.405	0.038	0.315	0.201	0.136	0.249	1	
6: Population management	0.686	0.025	0.478	0.317	0.524	0.507	0.278	1
7: Quality and performance	0.504	0.033	0.316	0.276	0.418	0.416	0.164	0.533
Interim PACT*								
1: Patient-centered care	0.683	0.027	1					
2: Access and scheduling	0.584	0.031	0.411	1				
3: Organization of practice	0.754	0.023	0.542	0.411	1			
4: Care coordination	0.700	0.026	0.451	0.421	0.533	1		
5: Use of technology	0.578	0.032	0.473	0.518	0.430	0.392	1	
6: Population management	0.579	0.032	0.484	0.342	0.427	0.415	0.354	1
7: Quality and performance	0.464	0.035	0.277	0.307	0.335	0.354	0.280	0.391

* The Medical Home Builder Survey was administered in October 2009 (pre-PACT, n=682) and July 2011 (interim PACT, n=681).

All factor loadings and correlations for both time periods were significant at $p<0.05$.

PACT: Patient Aligned Care Team; PCMH: Patient Centered Medical Home; SE: standard error.

Table 14: Coefficient estimates from the mediation structural equation model, pre- and interim PACT* for VHA primary care sites.

Variable†	**Pre-PACT** (n=682)					**Interim PACT** (n=681)				
	Unstd. Estimate	**Std. Estimate**	**SE**	**95% CI**		**Unstd. Estimate**	**Std. Estimate**	**SE**	**95% CI**	
Log RN/LPN rate ←										
PCMH	-0.508	-0.068	0.040	(-0.147,	0.011)	**0.728**	**0.102**	0.042	(0.019,	0.184)
VAMC	-0.117	-0.051	0.053	(-0.155,	0.054)	-0.064	-0.029	0.053	(-0.132,	0.074)
Log number of patients	0.036	0.033	0.050	(-0.064,	0.131)	0.041	0.039	0.049	(-0.058,	0.136)
Age 65 and older	**-0.010**	**-0.112**	0.040	(-0.191,	-0.034)	**-0.007**	**-0.087**	0.041	(-0.168,	-0.006)
Comorbidity	**0.040**	**0.164**	0.040	(0.085,	0.243)	**0.037**	**0.163**	0.042	(0.081,	0.245)
Log Hosp. rate ←										
Log RN/LPN rate	-0.032	-0.048	0.027	(-0.101,	0.004)	**-0.039**	**-0.057**	0.028	(-0.111,	-0.002)
PCMH	**-0.320**	**-0.065**	0.028	(-0.121,	-0.010)	0.008	0.002	0.031	(-0.059,	0.062)
VAMC	**0.789**	**0.521**	0.035	(0.452,	0.590)	**0.765**	**0.511**	0.036	(0.440,	0.582)
Log number of patients	**-0.085**	**-0.120**	0.035	(-0.188,	-0.053)	**-0.074**	**-0.103**	0.036	(-0.173,	-0.033)
Age 65 and older	**-0.016**	**-0.283**	0.028	(-0.338,	-0.229)	**-0.015**	**-0.250**	0.030	(-0.309,	-0.191)
Comorbidity	**0.046**	**0.289**	0.028	(0.233,	0.344)	**0.046**	**0.298**	0.030	(0.238,	0.358)
PCMH ←										
Log number of patients	0.001	0.007	0.041	(-0.073,	0.087)	**0.013**	**0.085**	0.042	(0.002,	0.168)

* The Medical Home Builder Survey was administered in October 2009 (pre-PACT) and July 2011 (Interim PACT). For all other variables, data was collected from two 12-month time periods. Pre-PACT period was from April 1, 2009, to March 30, 2010. Interim PACT period was from April 1, 2011, to March 30, 2012.

† Variables were defined as: log RN/LPN and log hosp. rate= log(number of events in period / number of patients)*1000. Log number of patients= log(number of Veterans aged 18 years and older who were assigned to a VHA primary care site for at least 10 months during the period). PCMH= latent factor comprised of the seven components of the Medical Home Builder Survey. Age 65 and older= the percentage of patients in a primary care site who were aged 65 years or older during the period. Comorbidity= percentage of patients in a primary care site with a Charlson comorbidity score >2. VAMC= binary variable indicating 1 if VAMC, 0 if CBOC primary care site.

Note: Estimates in bold are significant at $p<0.05$.

CBOC: Community Based Outpatient Clinic; CI: 95% confidence interval; MHB: Medical Home Builder; Hosp: inpatient hospitalization; LPN: licensed practical nurse; PACT: Patient Aligned Care Team; PCMH: Patient Centered Medical Home; RN: registered nurse; SE: standard error; std: standardized; unstd: unstandardized; VAMC: Veterans Affairs Medical Center; VHA: Veterans Health Administration.

Table 15: Goodness of fit indicators from the structural equation models, pre- and interim PACT* for VHA primary care sites.

Model†	Likelihood ratio χ^2 (df)	p-value	RMSEA	CFI	TLI	SRMR	CD	AIC	BIC
Pre-PACT (n=682)									
1	119.80 (49)	<0.0001	0.046	0.962	0.945	0.034	0.552	8306	8555
Interim PACT (n=681)									
1	120.20 (49)	<0.0001	0.046	0.964	0.947	0.033	0.513	7917	8166
2	120.20 (50)	<0.0001	0.045	0.964	0.949	0.033	0.513	7915	8160
3	124.34 (50)	<0.0001	0.047	0.962	0.946	0.033	0.506	7920	8164
4	125.99 (50)	<0.0001	0.047	0.961	0.944	0.038	0.513	7921	8166

* Pre-PACT period was from April 1, 2009, to March 30, 2010. Interim PACT period was from April 1, 2011, to March 30, 2012.

† Model 1 (mediation): PCMH→RN/LPN rate, RN/LPN rate→hosp. rate, PCMH→hosp. rate.
Model 2 (indirect effect of PCMH): PCMH→RN/LPN rate→hosp. rate.
Model 3 (PCMH as predictor): PCMH→RN/LPN rate, PCMH→hosp. rate.
Model 4 (PCMH and RN/LPN rate as predictors): PCMH→hosp. rate, RN/LPN rate→hosp. rate.

Note: → indicates the direction of the path between two variables in the model.

AIC: Akaike's information criterion; BIC: Bayesian information criterion; CD: coefficient of determination; CFI: comparative fit index; df: degrees of freedom; hosp: hospitalization; PACT: Patient Aligned Care Team; PCMH: Patient Centered Medical Home; RMSEA: root mean squared error of approximation; SRMR: standardized root mean squared residual; TLI: Tucker-Lewis index; VHA: Veterans Health Administration.

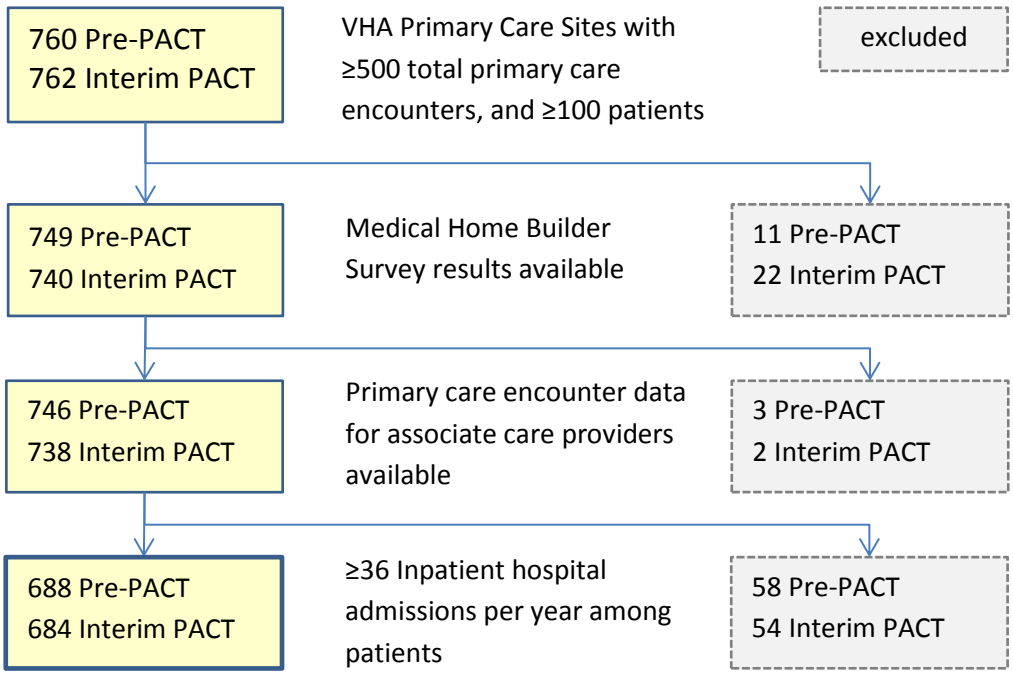


Figure 13: Flow diagram of VHA primary care sites included in the study.

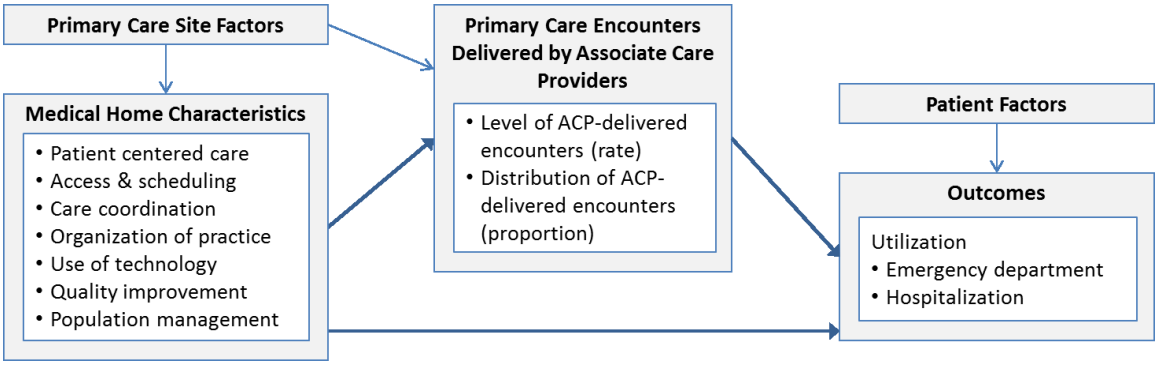


Figure 14: Conceptual model of ACP care as a mediator of the effect of the Patient Centered Medical Home and outcomes.

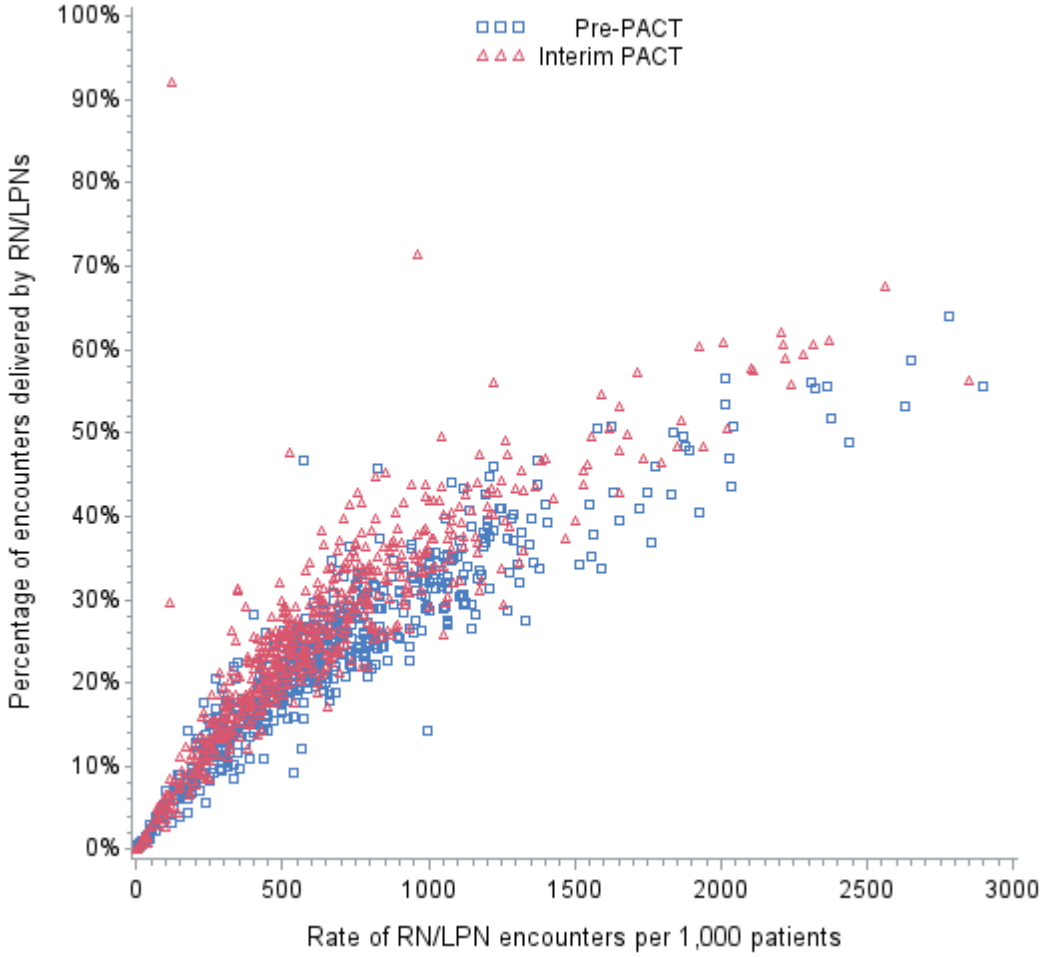


Figure 15: Scatter plot of the percentage of total encounters delivered by RN/LPNs by the rate of RN/LPN encounters among the primary care sites, pre-PACT (n=682) and interim PACT (n=681).

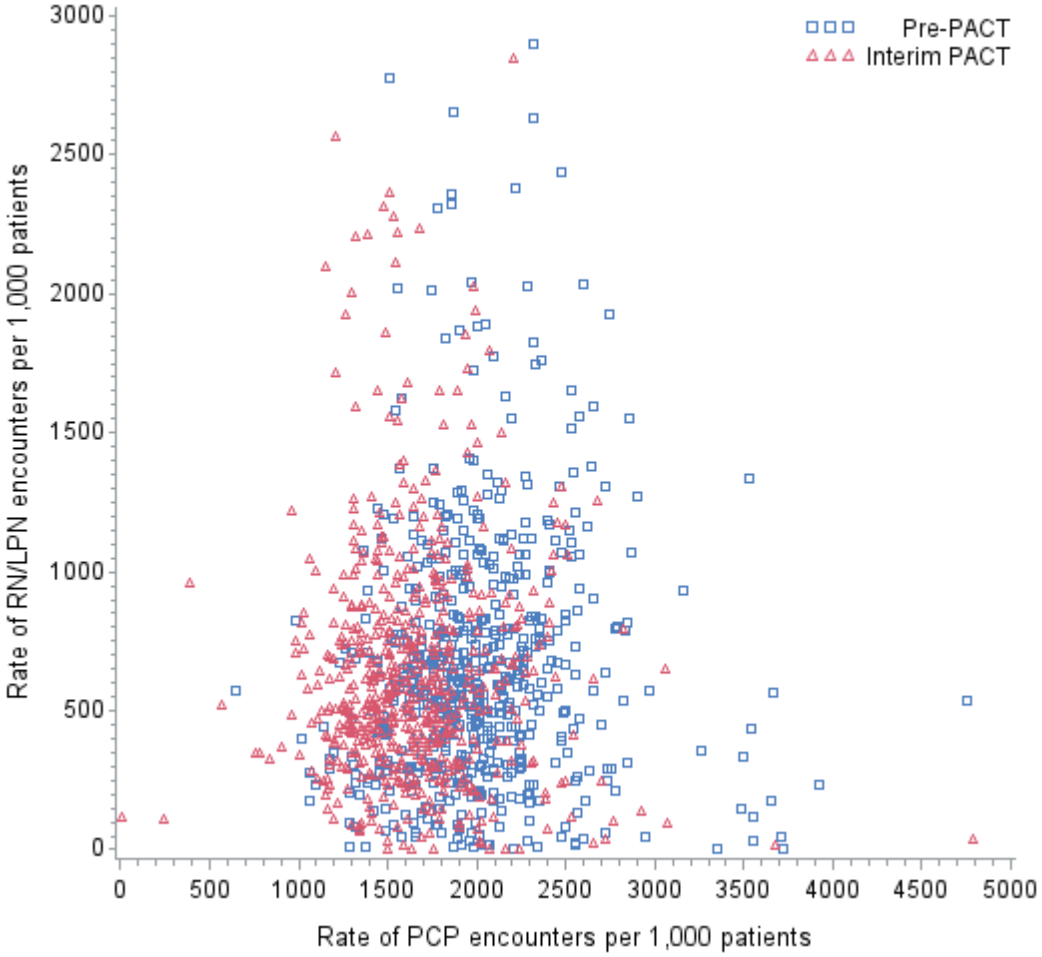


Figure 16: Scatter plot of the rate of RN/LPN encounters by the rate of PCP encounters among the primary care sites, pre-PACT (n=682) and interim PACT (n=681).

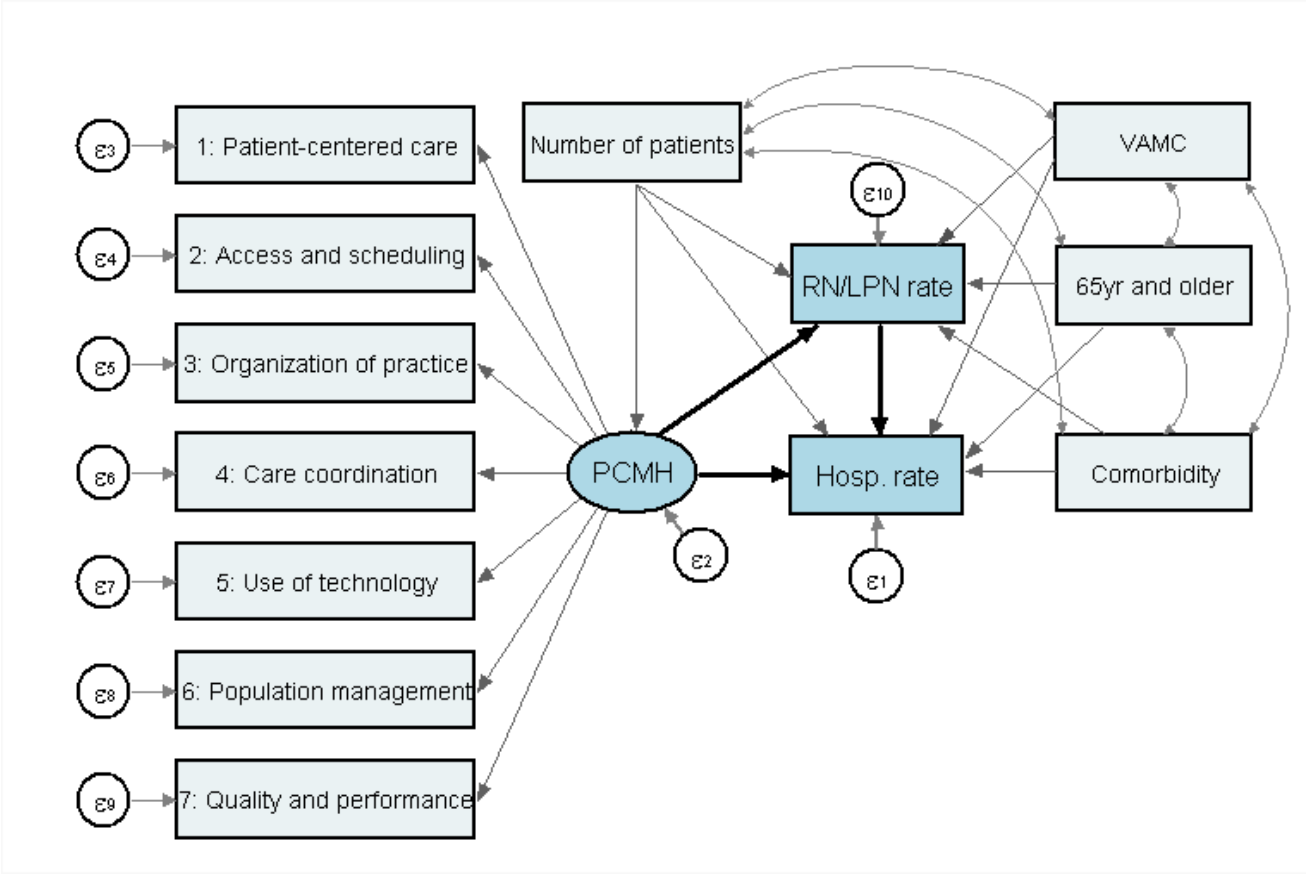
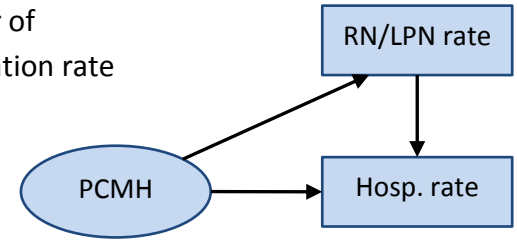
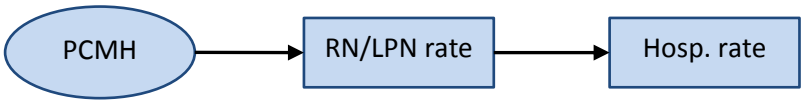


Figure 17: Hypothesized model of the rate of RN/LPN primary care encounters as a mediator of the effect of PCMH on the rate of hospitalization.

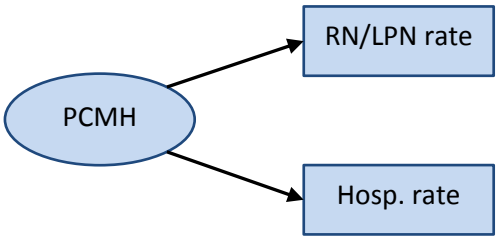
Model 1: RN/LPN rate as a mediator of PCMH effect on hospitalization rate



Model 2: Indirect effect of PCMH on hospitalization rate



Model 3: PCMH as independent predictor of RN/LPN rate and hospitalization rate



Model 4: RN/LPN rate and PCMH as independent predictors of hospitalization rate

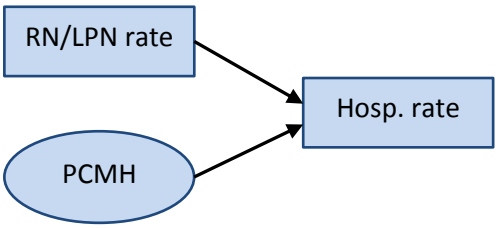


Figure 18: Hypothesized model (Model 1) and alternative models of the relationship between the rate of RN/LPN primary care encounters, PCMH, and the rate of hospitalizations.

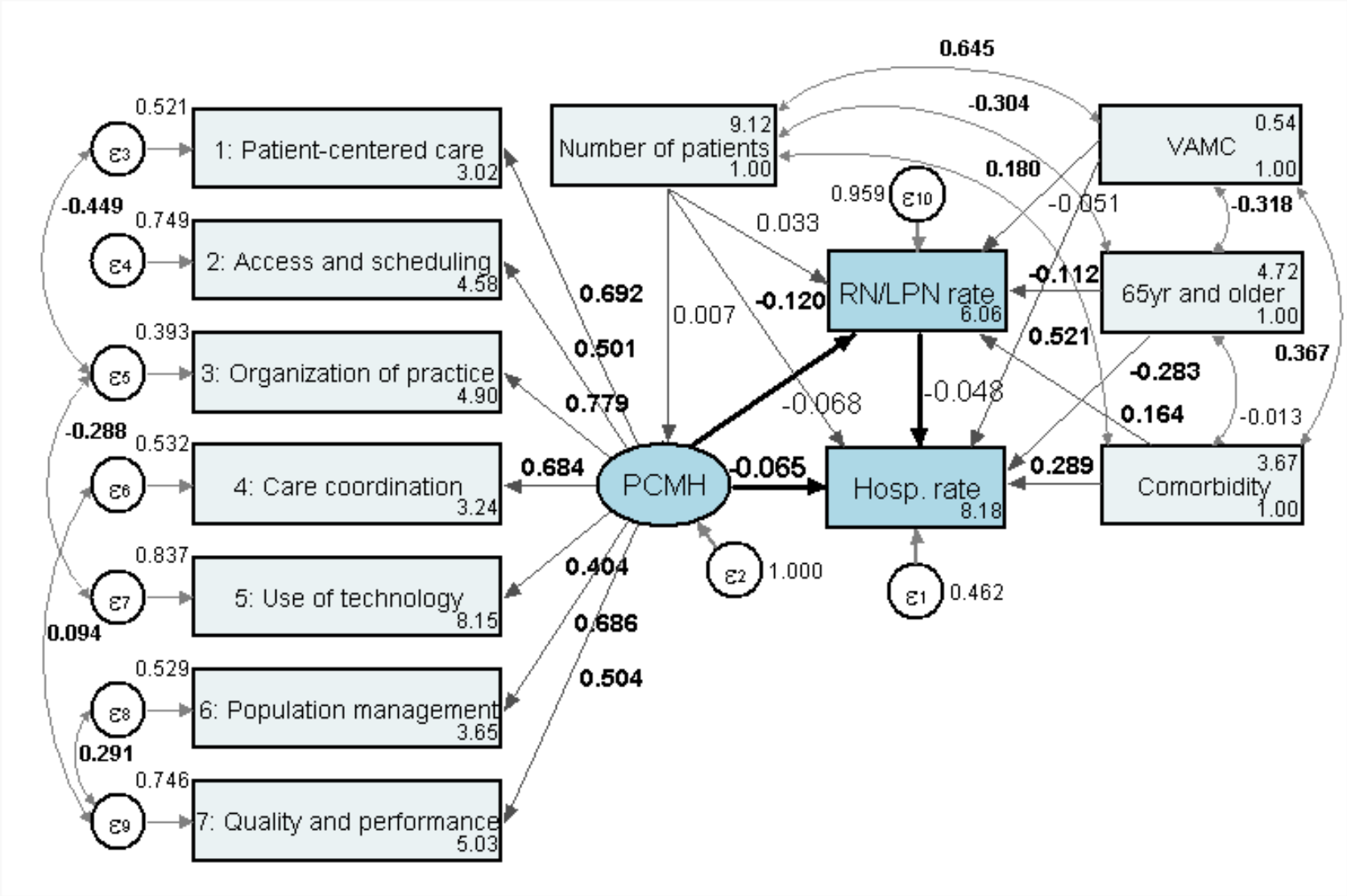


Figure 19: Standardized estimates of the structural equation model of mediation, pre-PACT period (n=682 primary care sites). Estimates in bold are significant at p<0.05.

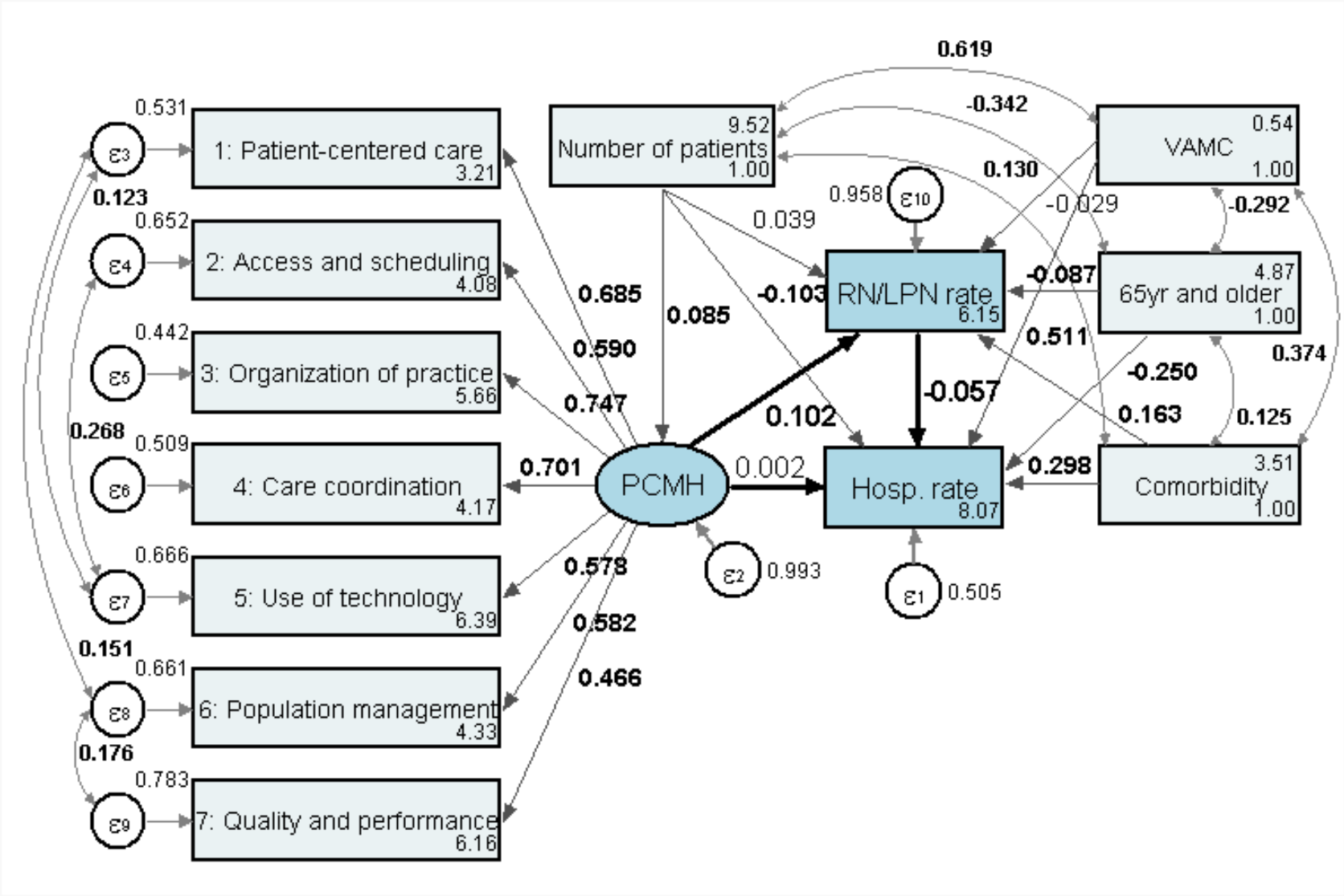


Figure 20: Standardized estimates of the structural equation model of mediation, interim PACT period (n=681 primary care sites). Estimates in bold are significant at p<0.05.

CHAPTER V: CONCLUSIONS AND IMPLICATIONS FOR RESEARCH AND PRACTICE

Overview of major research findings

This dissertation was an exploration of primary care delivery by associate care providers (ACPs), who, in collaboration with primary care providers (PCPs), perform an important role in improving primary care practice. ACPs contribute to expanding efforts to transform clinics into Patient Centered Medical Homes (PCMHs). As PCMH continues to be incorporated into major healthcare initiatives and policies, it is crucial to better understand the mechanisms by which it influences teams and the delivery of care to patients. Thus, this work specifically examined key aspects of ACP care in the context of PCMH: 1) measurement of ACP care activities and their inclusion in PCMH evaluation, 2) trends in primary care clinical encounters by ACPs after the introduction of PCMH, and 3) relationships between the level of PCMH implementation, ACP encounters, and health resource utilization outcomes. These issues provided valuable information about ACP involvement in primary care.

Measurement of ACP-delivered care

CHAPTER II reviewed 42 PCMH studies and found wide variability in how ACP care is operationalized (if included at all) in measures used to evaluate PCMH programs. Definitions of measures were often worded so broadly as to provide little account of the care shared and distributed among team members. And among

measures that were specific to individual providers, most focused on physicians and PCPs. For example, access to care was overwhelmingly measured as access to a PCP. No study included patient visits with ACPs as a measure of access.

Although a few measures did delineate ACP functions, there was inconsistency in the descriptions of tasks and role responsibilities that were assessed, ranging from patient education and self-management support to "friendliness." Moreover, only three studies linked ACP care to outcomes. The lack of detail regarding team-based care in PCMH measures limits the ability to infer an ACP-related effect on outcomes. It is evident that there is a need for a team-focused framework from which to guide measurement of care activities. In order for PCMH evaluations to provide meaningful and useful information that can be incorporated into practice, it is imperative that measures are reframed within a team context and reflect all the care being delivered in a clinic.

Trends in ACP-delivered care

CHAPTER III explored primary care encounter delivery by multiple provider roles within the Veterans Health Administration (VHA). Specifically, five-year trends in encounters by different ACP providers across a large number (n=764) of primary care sites was examined. Several findings suggested that a shift of workload from PCPs to ACPs had occurred after the introduction of PCMH. The number of in-person encounters by PCPs decreased, while those by ACPs increased during the time period. The portion of care performed by ACPs grew, representing 29% of all encounters in FY2009, and 35% in FY2013. And, the monthly rates of encounters for all types of PCPs significantly decreased over the five years, whereas the rates of some ACPs—

particularly nurses and social workers—significantly increased. Thus, it was evident that ACPs performed a substantial amount of clinical care in primary care sites, and that this amount of work had increased since PCMH implementation began.

Relationships between PCMH, ACP care, and outcomes

In an effort to better understand the relationships between the level of PCMH implementation, ACP-delivered care, and outcomes, CHAPTER IV tested a hypothesized model of a mediator effect of RN/LPN encounters. Higher PCMH scores at a clinic site level were significantly associated with higher rates of RN/LPN encounters, which, in turn was significantly associated with slightly lower rates of hospitalization, after controlling for a number of site- and patient-level factors. Additionally, there was a significant direct effect pre-PACT and indirect effect interim PACT of the level of PCMH implementation on inpatient hospitalization, suggesting that the introduction of PACT in VHA primary care sites altered the mechanism by which hospitalization was impacted. This information is an initial step towards linking ACP involvement in care delivery to PCMH implementation and outcomes.

Significance of work

Contribution

This work contributes to health services research in primary care and PCMH in several ways. Despite a multitude of literature examining PCMH programs and evaluations, none have specifically analyzed measurement approaches within the context of team-based care and ACPs. Previous literature reviews have focused on the effectiveness of PCMH in terms of specific outcomes (Alexander & Bae, 2012; Hoff et al., 2012; Jackson et al., 2013; Nielsen et al., 2012), rather than assessing the

comprehensiveness of the measures being used. This study identified important gaps in how PCMH measures are defined and applied as they pertain to ACP roles and care provided.

Additionally, although previous studies have analyzed primary care delivery by PCPs (Aparasu & Hegge, 2001; Dahrouge et al., 2014; Everett et al., 2013; Hooker & McCaig, 2001; Huang et al., 2004; Morgan et al., 2012), none have described encounters delivered by ACPs to this level of detail for several different types of providers. Thus, this work provides insight into the clinical encounters delivered by ACPs in primary care settings, which was previously not known. Moreover, changes in the distribution of encounters across provider roles and over time were identified.

Lastly, this study used existing administrative data to create an ACP-specific indicator (encounter rate), and applied this indicator in models to directly test relationships with PCMH implementation and resource utilization. In this respect, this work served as an initial exploration into how measures of ACP care could be conceived from health system data and feasibly used in evaluations, particularly those that assess the impact of teams in primary care.

Relevance

There has been a substantial push in recent years to improve the efficiency of primary care. These efforts are driven by key problems that have plagued primary care, including reduced access, and fragmented and uncoordinated care. The utilization of ACPs to provide access and care coordination services in clinical visits with patients helps meet these needs. Furthermore, the projected increase in demand for primary care services (Dall et al., 2013; Hofer et al., 2011), coupled with a projected shortage of

primary care physicians (Colwill et al., 2008; Jeffe et al., 2010; Kirch et al., 2012), create an environment in which team-based care and increased ACP clinical autonomy will be a necessity, rather than an ideal. Thus, this research addresses current health reform efforts by examining the full scope of provider-delivered care, beyond that of PCPs, and by measuring important aspects of team-based care. Findings are relevant to providers, researchers, and policy makers who are involved in primary care improvement initiatives, particularly the implementation and evaluation of PCMH.

Major healthcare improvement initiatives today are asked not only to demonstrate health benefits, but also to address healthcare costs in order to be sustainable. Thus, an emphasis in creating value-based payment mechanisms and performance-driven incentives has been at the forefront of national programs, such as the Affordable Care Act, Value-Based Insurance Design, and Accountable Care Organizations (Berwick, 2011; Chernew, Rosen, & Fendrick, 2007; Devore & Champion, 2011; "The Patient Protection and Affordable Care Act," 2010). Even the Joint Principles of PCMH include a focus on reimbursement (American Academy of Family Physicians, 2008). In this arena, it is increasingly more important to structure care delivery processes and incentives around teams (Blumenthal, Song, Jena, & Ferris, 2013). Furthermore, to demonstrate value-added impact, it is necessary to be able to measure and evaluate team-based performance, which includes measuring ACP-delivered care.

Major strengths

Veterans Health Administration

As the largest integrated healthcare system in the U.S., the large scope of over 700 primary care sites nationally provided a comprehensive assessment of ACP care delivery before and during PCMH implementation. Few other national PCMH programs are of this magnitude. This setting was ideal for studying ACP-delivered care due to the vast amounts of available data on clinical encounters, especially for some provider types (e.g., dietitians) that are less common in the clinics than other core team members. In addition, although individual clinic sites may differ somewhat in their documentation of clinical events, there are standard VHA policies that govern procedures for reporting these events. Encounter data is routinely documented for all types of providers in VHA. Conversely, documentation of clinical services in non-VHA primary care clinics is often tied only to reimbursable activities, and may not include care by all providers. Furthermore, the assigned Veteran population that utilizes VHA primary care is fairly stable over time, limiting some patient-level biases. Finally, this study was also advantaged by previous Patient Aligned Care Team (PACT) evaluation work conducted through the PACT Demonstration Laboratory, and thus benefited from the knowledge and experiences of VHA researchers.

Limitations

The Veteran population is primarily comprised of males, and therefore is not representative of the general U.S. population. Veterans with other sources of healthcare coverage, such as Medicare or private payer-based health insurance, often use non-VHA healthcare, which would not have been captured in these data.

Variability in encounter documentation at a site level could not be controlled for in analyses. Importantly, although an increase in ACP encounters and greater use of a variety of ACP roles in encounter delivery may indicate the presence of team-based care, the reverse may not necessarily be true. Less frequent ACP encounters may simply be a reflection of various ways in which ACPs are utilized in a particular site or in a particular team. There are potentially many types of care activities that do not end up as documented encounters. Thus, at a primary care site level, workload distribution is very individualized and influenced by the site's teams and providers, leadership, culture, and these characteristics were not accounted for in this study. Furthermore, the presence and number of providers within each site was not obtained, which prevented in-depth analyses of the availability of different types of providers in the sites and an assessment of whether this had changed over time.

Although frequently measured in PCMH evaluations, inpatient hospitalization may not be the best outcome for assessing an ACP-related effect. Ideally, measures of access to care, a more immediate outcome, may have provided better information. However, recent controversy surrounding common access measures in VHA has called into question the reliability of such reported outpatient events, and thus, was not used in this study (Government Accountability Office, December 2012).

Policy implications

It is evident there is a need to improve measurement and better understand ACP-delivered care within PCMH. Namely, assessment of ACP-related care activities informs workforce planning and policy. Workforce planning in an increasingly complex primary care environment requires knowledge of efficient use of care teams and team

members. This will take more than simply managing the numbers of providers to cover patient panels; it will take an understanding of how team-based care is maximized through the use of various types of providers in the team. Activities such as care coordination frequently utilize ACPs, often employing dedicated providers to function in that capacity (Fields, Leshen, & Patel, 2010). Therefore, it is critical to examine how provider roles have changed under the PCMH model, and how care is distributed across different provider roles.

Improved understanding of how teams distribute their workload to accomplish PCMH objectives is necessary for the continued progress and implementation of the model. As primary care transitions away from solo-physician practices towards larger, integrated systems with multidisciplinary professionals, the VHA PACT experience serves as a framework for the development and application of team-based care delivery processes, and lessons here are applicable to many healthcare systems in the private sector.

Directions for future research

This work sheds light on the need for further study of ACP involvement in primary care delivery. Foremost is a need to improve core measures used in PCMH evaluation to better reflect team-based care and the care activities by ACPs. Without measures that are sensitive to ACP care, the full impact of PCMH will not be realized. Future efforts should explore feasible ways to routinely access and utilize health system data to inform measures of team-based care and performance. Additionally, measurement approaches should encompass costs in order to align with current healthcare reform

efforts, which are incentivized by the potential cost savings that may result from increased use of ACPs.

To address the need for improved PCMH measures, future studies could continue this research by further examining ACPs and their role in primary care delivery. This work demonstrated that administrative data can be used to ascertain trends in care delivery by ACPs in the VHA health system. An extension of trending clinical encounters should be a thorough examination of the types of care activities occurring in primary care clinics, especially by ACPs. This information would be valuable for workforce planning efforts as well as clinical performance monitoring. Importantly, as a team-based model, PCMH encourages increased care responsibilities for ACPs, thus, these enhanced roles should be treated (and measured) as an intended outcome of PCMH implementation.

Lastly, this research found some evidence to support a link between nurse-delivered clinical encounters and hospitalizations. Future studies should evaluate possible effects of ACP care delivery on more immediate outcomes, such as emergency department utilization and clinical quality measures. These outcomes may provide valuable information about PCMH-related effects not previously realized. This work has laid a foundation for more extensive research on team-based care and ACP-delivered care in PCMH.

APPENDIX

Summary of the 42 articles included in the literature review.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Alidina, S. (2014)	Mixed methods, cross sectional, comparative pre-post PCMH	30 practices and 30 leaders in PCMH pilots in 3 states.	Assess the extent of adoption of PCMH structural capabilities.	NCQA PPC-PCMH survey of practices at baseline and 24 months post baseline. Interviews of one leader in each practice at baseline, 18 months, and 30 months.	17 items in the access domain of the 2008 NCQA PPC: scheduling with personal clinician; same day appointments; coordinating visits with multiple clinicians; phone advice with physician, nurse, or other clinician; email consult with physician or other clinician.	32 items in the care coordination domain of the 2008 NCQA PPC. Includes in Practice Organization specific "nonphysician staff" functions. Care coordination includes items that specify "physician and nonphysician." Care management: uses nonphysician staff to manage patient care; reminders for care.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Anderson, D. R. (2012)	Observational	10 nurses in 8 practices within a large FQHC implementing PCMH.	To understand how care coordination fit into nurses' role within PCMH.	Data collection tool used to record, categorize, and time tasks performed by nurses.	Study did not explicitly define access measures, but did measure nursing time related to access: 18% of nurses' time was spent on providing nursing visits independent of a PCP visit, and 10% of their time was spent talking with patients on the phone.	Categorized several nursing tasks as care coordination, including patient education and self-management, medication reconciliation, lab results review, collaboration with other providers (e.g., visiting nurse, specialist, ED, hospital). Care coordination activities accounted for 15% of nurses' workload.	None.
Aseltine, R. H. (2010)	Cross sectional	498 Connecticut primary care physicians affiliated with one of 3 professional medical organizations.	To examine the implementation of key PCMH features.	Survey to active primary care physicians who were members of professional physician organizations.	Asked physicians whether they had in place or planned to implement over the next 12 months: advanced access scheduling for physician appointments, primary care teams that share responsibility for patient care, and group visits with clinician. 57% had open access scheduling, 7% planned to have in next year, 36% had no plans to have. Open access associated with reduced appointment wait time.	Care coordination measured by survey item asking physicians whether they had in place or planned to implement over the next 12 months nurse care managers whose primary job is to coordinate and improve care for patients with chronic disease. 11% had nurse care managers, 9% planned to have in next year, 80% had no plans to have. 18% had primary care teams, 7% planned to have in next year, 75% had no plans to have. Practices with more physicians were more likely to have or have plans for care managers and teams.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Berry, C. A. (2013)	Cross sectional	94 practices with 5 or fewer clinicians serving Medicaid and minority patients in New York City and participating in the Primary Care Information Project.	To understand the extent to which small urban practices realize PCMH dimensions, and factors that predict PCMH adoption.	Administrative data and survey of lead clinicians, which measured 6 dimensions of PCMH.	7 access items: clinicians communicate with patients via email; open access scheduling; wait time for appointments; clinicians respond to patients outside of office hours; clinicians return patient calls same day; practice has arrangements for patients for evening or weekend hours.	9 team-based care items: care team; staff huddle; nonclinicians educate patients, take patient history, perform chronic disease screening; clinicians communicate with other clinicians outside the practice; practice staff meet to review and plan care. 17 care coordination items: designated care manager; monitoring and follow-up processes; clinician coordinating care with specialists and post-discharge; practice refers patients to community support. Continuity with personal physician.	None.
Birnberg, J. M. (2011)	Cross sectional	65 safety net clinics in 5 states that were participating in a PCMH demonstration	To develop a tool to evaluate PCMH interventions in safety net clinics	The Safety Net Medical Home Scale survey, containing 52 items in 6 domains	Access subscale: appointments with personal PCP; telephone advice on weekends or after hours; patients able to get same or next day appointment; regular office visits can be scheduled. Measures are specific to PCP only.	Care Management subscale: patients receive reminders about preventive or follow-up care; provider receives alerts about needed services for patients. External Coordination subscale: ability to get timely appointments with specialists.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Bruder, M. B. (2010)	Cross sectional	88 adults with disabilities living in Connecticut.	To assess the presence of a medical home among adults with disabilities in Connecticut.	54-item interview telephone survey based on PCMH research and models, which ascertained participants' perceptions of PCMH components. Survey questions not provided.	Access to a provider at a location; access at the appropriate time; physical access; financial access. Only 22% of respondents had health care that met all 4 criteria. Issues identified included: difficulty reaching provider via phone, long wait times, limited office hours.	Composite of questions about care coordination in a timely manner, and excellent or good perceived communication between doctors. 37% of respondents had adequate care coordination.	None.
Carvajal, D. N. (2014)	Cross sectional	1752 patients in 6 primary care sites in the Bronx (3 teaching, 3 non-teaching). 2 sites had PCMH implementation.	To examine patient experiences and estimate differences by teaching versus nonteaching sites.	Patient survey consisted of subscales of CAHPS and PACIC.	CAHPS subscale, which included 5 items of feasibility of making timely appointments, getting medical questions answered, and wait times.	PACIC subscales: patient activation, delivery system and decision support, goal setting, problem solving and counseling, and follow-up.	None.
Christensen, E. W. (2013)	Retrospective, pre- post-PCMH comparison of those with and without chronic conditions	4090 patients at Walter Reed, a large, military medical center.	To evaluate the impact of PCMH on access, quality, and costs.	Access and quality data obtained from patient survey, which derived from CAHPS and Primary Care Assessment Survey. Cost, utilization, and additional quality data obtained from administrative database.	Ability to see PCP when needed, ability to get routine and urgent care appointments, get timely answers to medical questions, wait time to see PCP, ease of scheduling appointments.	Not a focus.	Inpatient and outpatient utilization; costs; HEDIS measures; composite measures for access, patient satisfaction, provider communication, and customer service.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Coleman, K. (2010)	Cross sectional	554 FQHCs participating in the Safety Net Medical Home Initiative.	To determine the potential of safety-net health centers to become PCMHs.	Survey of FQHCs evaluated on 8 PCMH change concepts. Clinic sites completed the NCQA 2006 version of PPC-PCMH.	Scheduling patients with personal clinician; coordinating visits to multiple clinicians or tests; scheduling same day appointments; telephone advice by physician, nurse, or other clinician.	Nonphysicians share responsibility for: reminding patients of appointments, carrying out standing orders, educating patients, coordinating care with others. Stratified the following as provided by MD or ancillary staff: previsit planning, review care plan with patient, help patients set goals, medication review, assess barriers to goals, follow-up.	None.
Day, J. (2013)	Correlational, cross sectional	10 university-owned clinics serving 100,000 patients.	To evaluate Care By Design.	Assessment in 2011 of the implementation of Care By Design, a PCMH program introduced in 2003 in Utah. Internally developed tool covering access, care teams, and planned care.	6 items: same day appointments with provider, continuity with provider, attention to call center messages, contact with office via phone, electronic access to health information.	8 items of Planned Care: use of registries, pre-visit labs, medication reconcilliation, care plan progress and documentation, post-discharge follow up. These items are not specific to team member role. Continuity with medical assistant.	21 quality measures of chronic and preventive care services. Patient satisfaction measured by 8 items from Press Ganey's Medical Practice Survey. 15 items of clinician satisfaction. 9 measures of financial costs.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Driscoll, D. L. (2013)	Mixed methods, time series	45 stakeholders involved in Southcentral Foundation's PCMH implementation in an Alaskan medical center, which began in 1999.	To describe key elements of PCMH transformation in a tribally owned and managed primary care system, and evaluate changes in ED use during and after transition.	Semistructured interviews of 45 stakeholders, including primary care staff and tribal leaders. Time series of ED use.	Interview questions asked about stakeholders' perceptions and experiences of care, including access to care. Addition of staff was perceived as improving access. Open access resulted in overbooking, or the addition of unscheduled encounters, increasing staff stress. Overbooking was reduced with addition of new staff, including additional categories of PCPs and a case manager or scheduler for each team.	Interview questions asked about team-based care and transition to coordinated model. Respondents reported that some PCP workload was transferred to new staff roles, such as behavioral health clinicians and dieticians, and the addition of new staff roles was seen as an improvement. Disease specialist nurse roles were transitioned to broader case management roles as part of teams, allowing more proactive management.	ED utilization.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Ferrante, J. M. (2010)	Secondary analysis of cross sectional data	568 patients, staff members, and medical directors at 24 primary care practices in a family medicine research network.	To assess the effect of PCMH principles on preventive services.	Survey of patients aged 50 or older to assess satisfaction with care and perceptions of PCMH elements, including access. Chart audits to collect information on receipt of services. Practice member questionnaire to assess practice characteristics, communication, leadership. Medical director survey to obtain practice composition, practice volume, risk assessment tools, information technology, quality improvement.	2 patient survey items: appointment wait time, and getting through to office by phone. 2 director survey items: use of email with patients, and use of website for marketing.	2 practice member survey items: system for test results/consult tracking, and system for communicating results to patients. 2 director survey items: community program referrals, and clinicians make hospital/nursing home visits. Physician-directed team measured by 2 director survey items: presence of NPs and PAs, use of nurses or health educators for preventive counseling; and 1 practice member survey item: practice encourages nurse input for making changes. Continuity with physician in patient survey.	Rate at which patients were up-to-date on preventive services (cancer screening, lipid screening, influenza vaccination, behavioral counseling). System for community program referrals significantly associated with preventive services.
Fifield, J. (2012)	Randomized trial	18 intervention and 14 control practices. solo or small (2-10 providers) practices.	To test the effectiveness of providing external support, including practice redesign, care management and revised payment, compared to no support in transition to PCMH among solo and small practices.	2-year study included NCQA's PPC-PCMH survey of practices at baseline, 7 months (for intervention practices), and 18 months. Intervention included embedded nurse care managers to identify and engage complex patients.	Access and Communication domain of PPC-PCMH. Only cumulative domain scores reported, rather than individual items within a domain.	Care Management domain of PPC-PCMH. Only cumulative domain scores reported.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Friedberg, M. W. (2009)	Cross sectional	412 primary care practices sampled from a statewide quality improvement initiative.	To assess prevalence of recommended structural PCMH capabilities among primary care practices and evaluate their relationship to practice size and network affiliation.	Survey of 308 physicians in primary care practices having at least two physicians, sampled from a statewide quality improvement initiative. Survey assessed 13 key capabilities across 4 domains: patient assistance and reminders, culture of quality, enhanced access, and electronic health records. Compared prevalence of capabilities with number of physicians in practice and network affiliation.	3 access items: on-site language interpreters, clinicians' spoken language while delivering clinical care, and regular office hours on weekends. All 3 access indicators significantly associated with increased physicians in the practice and network affiliation.	3 patient assistance items pertaining to care coodination: specially trained staff to assist patients in chronic disease self-management, system for contacting patients who are overdue for preventive services, and reminders to provide guideline-based preventive care. Prevalence of specially trained staff and reminder systems significantly higher with an increase in physicians in the practices.	None.
Goldberg, D. G. (2009)	Cross sectional	342 primary care practices randomly sampled physicians obtained from the state board of medicine and located in 700 practices.	To understand the model of care and characteristics of family practices in Virginia.	Survey questionnaire of physicians that assessed 6 core PCMH features: personal physician, medical team, whole-person orientation, care coordination and integration, enhanced access, and quality and safety.	Access focused on alternative scheduling arrangements: rapid access, scheduled evening or weekend visits, telephone consultations, on-call evenings or weekends, e-mail consultations, and group visits. 96% of practices used at least one alternative scheduling option and 36% used three or more.	Several care coordination items focused on existence of patient registries for specific chronic diseases, presence of specific components of electronic medical record, community linkages, and linguistic services. Medical team items included whether the practice had ancillary staff: nurses, MAs, NPs, patient educators, PAs, mental health specialists. 87% of practices used at least one ancillary staff. Continuity with personal physician.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Hays, R. D. (2014)	Cross sectional	2740 patients in 6 practice sites affiliated with a health maintenance organization, 4 of which were PCMH.	To evaluate the reliability and validity of the CAHPS PCMH survey.	Field test of the CAHPS PCMH survey to a random sample of adult patients with at least one visit to a provider in previous month. Combination of web, mail, and telephone survey.	5 items: getting appointments for routine care, getting appointments for urgent care, getting answer to medical question during office hours, getting answer to question after office hours, and saw provider within 15 minutes of appointment time.	4 items: got test results as soon as needed, provider seemed informed about care from specialists, talked about prescription medicines, got help managing care. 2 items of self-management support: provider talked to you about health goals, and provider asked about barriers to self-care.	None.
Hearld, L. R. (2013)	Longitudinal analysis	831 statewide physician practices participating in the BCBSM Physician Group Incentive Program.	To assess the implementation of PCMH elements among physician practices.	Self-assessed survey of practices to ascertain their PCMH capabilities in place at 6 time periods over 26 months. Survey included 125 total capabilities across 12 domains. Compared relationships between implementation of capabilities and practice characteristics. Individual capability definitions not given, but obtained from BCBSM website.	Extended access domain measured the presence or absence of 9 capabilities: 24-hour access by phone; after hours provider for urgent needs; after hours provider has EMR or registry information; patients informed of after hours care; advanced access scheduling; and interpreters.	Individual care management domain measured the presence or absence of 15 capabilities: multidisciplinary team; use of evidence based guidelines; action plan, self management, goal setting; appointment reminders; follow up; group visits; medication management. Also included self-management support measured with 8 capabilities, and linkage to community services with 8 items. Coordination of care with 9 capabilities: notification of hospitalization; process for exchanging medical records; tracking care coordination.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Heyworth, L. (2014)	Cross sectional, comparative	921 patients that had shared medical appointments and 921 matched usual care patients from a large primary care practice.	To explore the influence of shared medical appointments on patient experience within primary care with respect to patient-centered care.	Study compared patients that had shared medical appointments during a 3-year period to those that did not. 90-minute shared medical appointments were facilitated by care team. Press Ganey questionnaire administered to patients that reflected 5 domains of core PCMH principles: enhanced access, visit coordination and quality, physician communication, team-based care, and whole-person orientation.	4 items: ability to get desired appointment, convenience of office hours, promptness in returning calls, wait for laboratory tests. Patients with shared medical appointments reported better access in 3 of 4 indicators.	4 coordination items: speed of registration, wait for clinician in exam room, clinician had information to diagnose/treat, clinician information from specialists. 4 items of physician communication: clinician explanation of condition, information given by clinician about medication, clinician time spent with patient, concern expressed by clinician. 2 items of team-based care: friendliness of nurse/assistant, concern nurse/assistant showed for problem. Patients with shared medical appointments reported worse physician communication.	One item of patient satisfaction: overall rating of care provided during visit. Patients with shared medical appointments reported higher overall satisfaction.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Hochman, M. E. (2013)	Cross sectional, comparative pre-post PCMH intervention	600 patients and over 180 residents at 3 primary care internal medicine clinics at an urban academic safety-net medical center: 1 intervention clinic and 2 control clinics.	To evaluate an intervention guided by PCMH principles at a safety-net primary care clinic with internal medicine residents.	PCMH intervention included access, care coordination, and team-based care. Modified CAHPS survey of patients, and clinic satisfaction survey of residents, pre and 12 months post intervention. Additional survey of residents who worked with care managers to triage patients and assist with case management. Compared pre- and post-intervention periods among intervention and control clinics.	4 items from patient survey: ease of making urgent appointments, ease of making routine appointments, telephone access during regular hours, telephone access after hours. Significant improvements in access indicators occurred in intervention clinic versus control clinics.	5 items from patient survey: test results communication, ease of completing tests, ease of making specialist appointments, continuity with regular physician, physician knows information about patient. No significant improvements in coordination indicators were found.	Change in patient and resident satisfaction between pre- and post-intervention in intervention vs. control clinics. ED visit rates for avoidable conditions, and hospitalizations one year before and one year after intervention. Patient and resident satisfaction improved post intervention. No change in ED post intervention. Slight decrease in hospitalizations.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Jaen, C. R. (2010)	Randomized trial	29 practices enrolled in the National Demonstration Project (NDP) randomized to facilitator and no facilitator, and 1827 patients in the practices.	To evaluate patient outcomes in the NDP of practices' transition to PCMH, and to evaluate whether a practice facilitator would improve NDP adoption in practices.	Evaluation of patient outcomes from the 2-year NDP. Randomization of 36 practices to facilitated or self-directed intervention groups. Repeated cross sectional patient surveys and medical record audits for patient-rated and quality of care outcomes at baseline, 9 months, and 26 months. Measured practices' PCMH progress by the presence of 39 components including access and care coordination.	6 access components from ACES: same-day appointments, lab results accessible, online patient services, e-visits, group visits, after hour coverage. 4 patient-rated access items included as outcomes: help as soon as needed for injury/illness, appointment for care as soon as needed, answer to question same day when calling during office hours, and advice when calling after hours. No improvement seen in patient-rated access outcomes. Adoption of NDP only associated with patient-rated access.	4 care management components from CPCI: population management, wellness promotion, disease prevention, patient engagement and education. 5 patient-rated care coodination items included as outcomes: keeps track of my care, follows up on problems, follows up on visit to other health professionals, helps interpret tests or visits to other health professionals, communicates with other health professionals I see. No improvement seen in patient-rated care coodination outcomes.	Several patient-rated outcomes obtained from surveys, and several quality of care metrics obtained from medical records. Facilitated practice implemented more PCMH components. Only condition-specific quality of care indicators improved. NDP components and patient-rated outcomes poorly correlated.
Kennedy, B. M. (2013)	Qualitative	32 patients in one PCMH site.	To obtain input from patients that could be used to improve their PCMH experiences related to disease management and health improvement.	Qualitative study of patients' perspective of PCMH at one medical home site. Conducted individual cognitive interviews of 15 patients, focus groups with 17 participants, and surveys of all study participants.	Access measured by: ease of obtaining appointment, time it takes to see doctor at appointment, ease of obtaining care at clinic. Patients reported more frequent appointments and reduced wait time would improve access.	Care management measured by: clinic follow-up for test results, clinic educates patients about health and medications, clinic ensures patients receive needed screening or procedures. Patients reported that better communication between doctors and nurses would improve PCMH experience.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Kern, L. M. (2013)	Cross-sectional, comparative prospective, pre-post PCMH	715 patients receiving primary care in NY among 10 adult practices that had earned NCQA level 3 PCMH.	To measure patients' experience over time in practices that transformed into PCMHs.	PCMH transformation was supported by an IPA and consulting groups. Lead physicians met monthly to coordinate efforts and share best practices. Measured patient experience via 35 questions from the 2007 CG-CAHPS, and 14 questions from ACES, which covered 7 PCMH domains. Patients sampled from two time points: at baseline and a median follow up of 15 months.	Only access items that were significant were reported: how often did you get an appointment as soon as needed when calling the office, and how often did you see doctor within 15 minutes of appointment time. Access significantly improved over time, driven by improved appointment availability and decreased wait time.	Domains related to care coordination included: communications and relationships, disease management, doctor communication, follow-up of test results. Only items that were significant were reported: how often did the doctor spend enough time with you, and how often were clerks and receptionists helpful. Improvements seen in the perception of the amount of time doctors spent with them and the helpfulness of office staff.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Khanna, N. (2014)	Cross sectional	60 staff among 32 primary care practices in Maryland multipayer PCMH pilot.	To determine the improvements and challenges pilot practices have during PCMH transformation. To assess changes in practice 18 months after PCMH implementation.	Survey of staff: 14 items in 3 domains- care coordination, efficiency, and technology. Compared staff perceptions of change in care processes at 18 months after PCMH implemented.	Efficiency domain included 2 access items: patients can get an appointment within 24 hours of contacting practice; practice is able to efficiently provide access to care for patients.	5 items: team schedules post-discharge follow-up; complex patients are referred to care management team; patients receive coordinated care with self-management and community linkages; consistent medication treatment management for patients taking high-risk medications; team reviews patients' disease prevention needs. Care management rated higher at 18 months post-PCMH. NP/PA had lower total change scores, MA had higher change scores than MD.	2 survey items: understanding of patient-centered care; providing care as envisioned when leaving residency/training. Understanding of patient-centered care rated higher at 18 months post-PCMH. NP/PA had lower total change scores, and MA had higher change scores than MD. Results for individual survey items not given by provider type.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Lebrun-Harris, L. A. (2013)	Cross sectional	4562 participants of the 2009 Health Center Patient Survey, a random, national sample of patients seen in health centers.	To assess patient perceptions of key PCMH attributes and quality of care.	2009 Health Center Patient Survey, national sample. 4 domains of PCMH--access, communication, self-management support, and comprehensive care.	Several items in survey dropped based on factor analysis. 2 items included in study: patient ratings of getting there and during the visit.	Several items in survey dropped after factor analysis. Self-management support includes 'nurse call'. 2 items included in study: self-management support for chronic diseases and behavioral risks; 1 item for comprehensive care: preventive services. 2 communications items: communication with clinicians and support staff.	3 outcomes of quality: overall quality, quality of clinican treatment, likelihood of referring family to health center. Both the access and communication items were significantly, positively associated with patient perception of quality.
Lewis, S. E. (2012)	Cross sectional	603 providers and staff in 65 safety net centers in 5 states participating in the Commonwealth 5-year PCMH demonstration.	To determine whether perceived PCMH characteristics are associated with staff morale, burnout, and job satisfaction in safety net clinics.	Mailed self-administered survey of providers and staff. Survey domains based on 2008 NCQA PCMH standards, including 5 subscales: access and communication with patients, communication with providers, tracking data, care management, and quality improvement.	5 items: patients see usual provider for routine/urgent visit; patients with urgent needs can easily get same-day appointment with provider; difficulty spending enough time with patients to meet needs; adequate access to interpreters.	7 items: clinic identifies high-risk patients; clinic intensifies services for high-risk; clinic individualizes services; clinic effective in helping patients self-manage chronic illness; care is coordinated among staff (MD, nurses, staff); practice uses community resources; EMR provides reminders.	3 ratings: staff morale, job satisfaction, burnout. Access was significantly associated with increased staff morale and job satisfaction. Care management was associated with higher staff morale.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Maeng, D. D. (2013)	Secondary analysis of cross sectional survey data, comparative	499 ProvenHealth Navigator (PHN) patients and 356 non-PHN patients in 43 practice sites.	To compare patient care experiences between those in Geisinger's PCMH model, PHN, and those in traditional primary care.	Survey of PHN and non-PHN patients. 4 domains of care: perceived changes in care delivery, usual source of care, access to care, and PCP performance.	5 items: how quickly patients could get an appointment with PCP or other health care professional; difficulty contacting someone via phone during office hours; difficulty getting medical advice in evenings/weekends; getting appointment with specialist within a week; how quickly someone followed up regarding test results. PHN patients were not more likely to report better access than non-PHN patients.	Perceived difference in the coordination of care. PCP performance measures also included: how often were nurses/receptionist helpful with scheduling appointments or getting referrals; how often did your PCP and team seem informed about specialist/hospital/ ED care; doctor's office helps schedule preventive care. PHN patients more likely to report a change in care coordination.	None.
Martinez-Gutierrez, J. (2013)	Qualitative	18 staff personnel in 4 FQHC clinic sites.	To obtain the perspectives of clinical personnel at a FQHC on organizational factors that can affect the delivery of cancer care services.	15-item semi-structured interviews of clinic personnel to assess organizational readiness to deliver cancer screening and barriers/facilitators of screening. Researchers used the NCQA PCMH standards as theoretical and analytic framework, which included access and care management/coordination.	Measured facilitators and barriers to patient access to screening. Participants reported that programs that pay for screening was the most important factor influencing patient access to screening. Other factors included availability of Spanish-speaking staff and educational materials.	Survey measured care coordination by asking about ability to follow-up on screening recommended to patients, and who does the follow-up. Participants reported teamwork as important in identifying patients for cancer screening. Non-physician staff dedicated to preventive services and coordinating screening with patients' routine visits were facilitators in screening. Issues with coordination included unclear tracking systems and relationships/communication with referring sites.	None.

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Mead, H. (2014)	Qualitative, phenomenological	387 patients in 10 nationwide safety net communities.	To understand where the PCMH model meets the needs of low income patients with heart disease, and where further development may be warranted.	Compared PCMH principles to patients' perspective of patient-centered care elicited during 33 focus groups. Focus groups covered 5 domains: access to care, coordination of care, communication with providers, ability to self-manage illness, and overall satisfaction with care. 7 priorities important to participants: communication/partnership with physicians, affordable care, coordinated care, personal responsibility, accessible care, education and support resources, and essential role of nonphysicians.	Focus groups included access to care as a measured domain. Patients identified wait times and scheduling issues as barriers, and alternative modes of communication (phone, email) as potential strategies to improve access.	Focus groups included care coodination as a measured domain. Patients identified non-physician providers as having a key role in care management.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Moore, A. D. (2013)	Descriptive correlational	200 active duty army soldiers or adult family members eligible for care at military site in Hawaii.	To determine which individual characteristics are predictors of patient satisfaction and health status.	Several self-administered questionnaires included: individual characteristics and patient outcomes.	Perceived Access to Health Services scale included 10 items that assessed an individual's ability to access medical care with respect to cost, convenience, and feasibility. Actual questions in the tools not provided.	PCAS measured continuity with provider.	Physical health and mental health status. Also patient satisfaction: satisfaction with wait time, time spent with provider, information received, quality of care, cost of care. Perceived access was significantly positively associated with patient satisfaction and negatively associated with physical and mental health.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Nelson, K. M. (2014)	Observational	913 VHA primary care sites that serve 5.6 million veterans; 5404 primary care staff; and 75,101 patients.	To create an index that measures the extent of PCMH implementation, describe variation in implementation, and examine the association between the index and key outcomes at VHA primary care clinics.	Development of the PACT Implementation Progress Index (PI2). 53 items included in index. Measures obtained from administrative data, a national CAHPS PCMH patient survey, and a survey of all VHA primary care staff. Assessed relationships between PCMH implementation scores and patient satisfaction, staff burnout, utilization, and quality of care outcomes.	11 items (6 from CAHPS, 5 from administrative data) including: availability of appointments, getting medical questions answered same day, same day appointment access, enhanced access/telephone clinics, electronic access. Access indicators combined with other indicators in PI2 score, and not analyzed individually.	7 items of care coordination including: test result follow-up, provider informed about specialist care, post-hospital discharge contact. 18 items of team-based care including: PCP relies on RN care manager for tasks including preventive services, prescription refills, patient education, and test tracking; and time spent in team huddles, recommended staffing ratios. Continuity of care. Indicators combined in PI2 score, and not analyzed individually.	1 item of patient satisfaction. 4 items of staff burnout. Several quality of care measures pertaining to chronic disease management, preventive care, and behavioral health screening. Utilization included ED and urgent care visits, hospitalization, hospitalization for ambulatory care sensitive conditions.
Nocon, R. S. (2012)	Cross sectional	669 federally-funded health centers across all 50 states	To determine whether PCMH rating is associated with operating costs among health centers funded by HRSA.	Survey of administrators of 669 federally-funded health centers. PCMH rating measured by the Safety Net Medical Home Scale (SNMHS) consisting of six domains. Assessed relationship between PCMH rating and operational costs, obtained from the 2009 Uniform Data System reports.	SNMHS, Access subscale: appointments with personal PCP; telephone advice on weekends or after hours; patients able to get same or next day appointment; regular office visits can be scheduled.	SNMHS, Care Management subscale: patients receive reminders about preventive or follow-up care; provider receives alerts about needed services for patients. External Coordination subscale: ability to get timely appointments with specialists.	Operational costs: costs per physician FTE, costs per member per month, costs per medical visit. Costs had a significantly positive correlation with care management and external coordination subscales.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Rittenhouse, D. R. (2011)	Cross sectional	1344 practices with 1-19 physicians.	To assess the adoption of 4 principles of PCMH: physician-directed practice, care coordination, quality and safety, and enhanced access.	Telephone survey of practices used to create summary PCMH score from 17 domains. Compared practice characteristics (size, ownership, patient population) to the adoption of PCMH principles.	Access measured by 2 domains: use of group visits, and use of email for communication between physicians and patients.	Care coordination measured by 5 domains: use of electronic medical records, electronic access to information from specialists and hospitals, electronic prescribing, use of chronic disease registries, and use of nurse care managers for severely ill patients. Use of nurse care managers higher in practices with more physicians.	None.
Rittenhouse, D. R. (2012)	Observational	Over 50 New Orleans primary care safety-net clinics.	To describe a natural experiment in which diverse safety-net clinics were transformed into PCMHs in New Orleans after Hurricane Katrina.	Evaluation of the community-wide implementation of PCMH processes. Included semiannual telephone surveys of clinic staff, and administrative data over 2 years. Survey adapted from items from the National Study of Small and Medium Physician Practices and the 2008 NCQA-PCMH survey tools. Examined 3 PCMH components: enhanced access, quality and safety, and care coordination and integration. Administrative data included number of patients and encounters.	8 domains: open before 8am or after 5pm, open on weekends, provides telephone advice during office hours, responds to call after hours or on weekends, routinely collects data on access, provides translation services, communicates with patients via email, and has interactive website. Access improved over time, but then decreased during the last time period.	9 domains: uses electronic medical record, can retrieve reports electronically, shares electronic record with hospital, has electronic access to information from hospitals/EDs and specialists, alerts providers when patients are hospitalized, uses order tracking system, has electronic prescribing, uses chronic disease registries, and uses care managers for chronic diseases. Coordination improved over time, but then decreased during the last time period.	Number of patients served, and number of encounters. Both increased during the study.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Rosland, A. M. (2013)	Retrospective, longitudinal data analysis	850 VHA clinic sites nationwide.	To describe PACT and evaluate interim changes in PACT-related care processes.	American College of Physicians Medical Home Builder Practice Survey of clinic sites pre- and interim PACT. Survey has 127 PCMH components among 7 domains. Operational data used to assess trends in key care processes over 2 1/2 years.	8 items: inperson visits with any provider or staff; dedicated phone hours for patients to reach clinician; phone encounters with any provider or staff; same-day appointments; patients seen within 7 days of desired date; patients enrolled in personal health record; patients using secure messaging; group visit encounters. Access indicators improved during the study period.	2 items: percentage of patients using telehealth monitoring; patients contacted within 2 days of hospital discharge. Also included reach of RN care management. Both indicators of coordination increased during the study period. Continuity of care with PCP.	None.
Savage, A. I. (2013)	Mixed methods, pre-post PCMH	36 staff in a primary care clinic in a military treatment facility serving 13,000 patients.	To examine access to care, ED utilization, population health HEDIS measures, and staff satisfaction 2 years after PCMH implementation.	Study of access, ED, HEDIS measures, and staff satisfaction in a military primary care clinic. Population health and HEDIS data obtained from Command Business Report, a pay-for-performance report, for 2 years prior and 2 years after PCMH implementation. Staff satisfaction survey obtained at end of study.	4 indicators: acute visit (appointment booking within 24 hours), well visit (booking within 28 days), routine visit (booking within 7 days), and procedures (booking within 28 days). There was a nonsignificant decrease in acute visits, a significant decrease in procedures, and a significant increase in well and routine visits after PCMH. Access increased by 7%.	Not measured.	ED utilization, HEDIS measures, staff satisfaction. ED utilization decreased by 75%; HEDIS measures improved; high staff satisfaction 2 years after PCMH.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Schmidt, L. A. (2013)	Multilevel cross-sectional analysis	1573 patients and 26 primary care leaders in 26 safety-net clinics in New Orleans.	To test the hypothesis that PCMH improvements in safety-net primary care clinics are associated with a more positive patient experience.	Survey interviews with leaders. In-person interviews with a representative random sample of patients served by the 26 clinics. Retrospective administrative data for 6-month time period.	Accessibility (used as outcome) included 3 items: ease of getting medical advice from clinic by phone during open hours, on evenings/weekends/holidays, and receiving care on same or next day appointment when ill.	Care coordination (used as outcome) included 2 items: having a regular doctor, and having the clinic coordinate care with other health care providers. Patient experiences of care coordination positively associated with clinic use of PCMH structural and process changes.	Accessibility, coordination, and confidence in the quality and safety of care.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Stevens, G. D. (2014)	Cross-sectional	540 patients with Medicaid and type 2 diabetes with a primary care visit in Los Angeles county.	To assess the impact of 7 features of PCMH on diabetes care.	Survey to assess patient-reported indicators of PCMH quality was the Primary Care Assessment Tool (PCAT) Adult Expanded, containing 96 questions across 7 features: first-contact care, continuity of care, comprehensiveness, coordination, community-oriented care, family-centered care, and cultural competence. Total overall score was the average across all features.	2 access concepts in first-contact care domain: services are accessible (structure), and utilization occurs when a need arises (process). Actual survey questions not provided.	2 coordination concepts in the coordination domain: arranging for and following up on specialist health services, including effective information systems (structure), and use of the information as it relates to current needs for integration of patient care (process).	2 concepts--diabetes care and diabetes education received: when last HbA1c test was done, whether physician gave patient a plan to manage care at home; whether patient met with dietician; whether patient had diabetes education outside of office visits; whether physician had discussed any of 9 care topics with patient, including self-managing disease, and community resources. Patients with a home care plan were more likely to have better access and coordination.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Takane, A. K. (2012)	Qualitative	18 patients of two family health centers in Hawaii participating in a PCMH project.	To obtain patient perceptions on specific components of PCMH to aid in its implementation at the health centers.	Four focus groups conducted. Questions were based on the ACP MHB PCMH Assessment tool. Central themes were quality care, provider/health services accessibility, and communication and coordination with and among providers and staff.	Access issues were identified in focus group discussions: need for specialists; long waits to obtain services; transportation.	Care coordination issues were identified in focus groups: desire for a team approach to care--recommended coordinating care with PCPs, specialists, nutritionists, social workers, and pharmacists; front desk staff were seen as important because they are first point of contact; need for more health education resources; RNs seen as important to keep doctors informed.	None.
Taliani, C. A. (2013)	Mixed methods	136 clinicians and staff in 25 NCQA-recognized PCMH practices participating in a regional learning collaborative.	To explore how a disparate group of PCMHs embedded care management in their team care environment to identify best practices.	Semistructured interviews of 136 clinicians and staff in 21 of the 25 practices. Interviews focused on experiences with implementing PCMH, role, and level of adoption. Practices were ranked and divided into performance tertiles based on improvement in 3 diabetes measures. Qualitative interview data analyzed to contrast care management implementation in practices with high and low performance improvement in 3 diabetes measures.	Not a focus.	Practices with highest diabetes performance described care managers as providing several patient-centered care activities, including self-management health coaching and patient education, and regularly collaborating with providers in huddles about patient care. Practices with low diabetes performance described care managers as having more of an administrative role instead of providing direct patient care, and were reported to have less frequent meetings with providers.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Ulrich, F. A. (2013)	Cross sectional	Stratified national sample from the AMA Masterfile of 1429 physicians with a specialty of primary care.	To assess the readiness of metropolitan and nonmetropolitan primary care practices to provide PCMH services to patients.	2008 Health Tracking Physician Survey, a national survey of US physicians consisting of almost 300 questions. PCMH-relevant questions were mapped to 71 of the 100 possible points in the 2008 NCQA PPC-PCMH tool.	Not described.	Full survey questions not provided. Coordination-related questions mapped to NCQA items: actively supports patient self-management, tracks tests and referrals. Practices with three or more physicians scored higher in care management, patient tracking and registry, and test tracking than those with two or less.	None.
Van Berckelaer, A. (2012)	Qualitative	17 patients at 3 urban academic internal medicine practices, one of which was NCQA level 3 PCMH.	To obtain patient input regarding their understanding of patient centered care and specific components of PCMH.	Conducted 3 focus groups with patients at 3 practices. 3 focus areas were: quality of care, teams, and access; diabetes self-management; and community connections and services. Stratified sampling to obtain certain patients in each focus area. Questions were based on core PCMH elements. All groups were asked to define patient-centeredness; additional questions pertained to the specific focus of the group.	The quality of care focus group was asked about their experiences with different types of clinicians (MD, NP, resident), communication preferences with their practice and providers, and the role they would like to have in their care. Patients reported difficulty accessing the practice by phone, and having long wait times. Recent changes in the process for making follow-up appointments in the practice was intended to provide enhanced access, though this was confusing for patients.	The diabetes group was asked their preferences for the composition of their care team, and their opinion of group visits. The community group was asked their preference for their practice's involvement in community. Patients felt that the practice should provide patients with information about community resources. Group visits were also seen as beneficial.	None.

Author / Year	Research Design	Population / Setting	Aim(s)	Methods	Access to Care Measures	Care Coordination Measures	Outcomes
Yoon, J. (2013)	Cross sectional	814 VHA primary care clinics	To assess whether the adoption of PCMH features is related to lower risk and cost of hospitalization for ACSCs.	Patient-level utilization and cost data of 2,853,030 patients linked to clinic-level survey data for 814 sites.	Access measured by 9 MHB items related to: scheduling with personal clinician, same-day appointment with clinician, open access scheduling, group visits, dedicated phone hours with clinician, clinical advice with clinician or nurse, and use of email. Access domain significantly related to decreased ACSCs.	Care coordination measured by 18 MHB items related to: coordinates visits to other clinicians, chart review prior to visit, individualized care plan and monitoring, assesses patient barriers to progress, communication and information sharing across entities/facilities, medication reconcilliation, coordinates post-discharge care, helps patients find physicians. Uses the term 'practice' for most activities and does not specify team member. Care coordination significantly related to decreased ACSCs.	Risk and cost of hospitalization for ACSCs. Greater overall PCMH features was significantly related to decreased ACSCs.

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