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Essays on the Patient-Centered Medical Home in the United States Military Health System

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by

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DISCLAIMER

While it should not create a bias, in the interests of full disclosure, it should be noted that the author of this dissertation is an officer in the United States Air Force (USAF). The views expressed in this dissertation are those of the author and do not reflect the official policy or position of the USAF, Department of Defense or the U.S. Government.

Essays on the Patient-Centered Medical Home in the Military Health Service

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The Patient-Centered Medical Home has been endorsed by the primary care community as the model of the future, with hopes that it will increase quality of care and the patient and provider experience while decreasing costs. Many aspects of the implementation of the Patient-Centered Medical Home model remain unexplored. This dissertation comprises three independent studies examining Patient-Centered Medical Home implementation in the Military Health System, including (1) the effects of environmental correlates on the time to implement the model, (2) the impact of differences in implementation on preventive care quality outcomes, and (3) the effect of differences in implementation on chronic care quality outcomes.

Survival analysis was utilized to analyze the effect of environment, defined as resources and governance, on how long it took Military Health System clinics to adopt the Patient-Centered Medical Home model. Clinics were assumed to have adopted the model when they achieved National Committee on Quality Assurance recognition. Differences-in-differences models were created to compare both preventive and chronic care quality outcomes in Military Health System clinics by branch of service before and after Patient-Centered Medical Home implementation. Dependent variables included Chlamydia and various cancer screenings as well as heart condition and diabetes care HEDIS metrics. Measures were drawn from Military Health Mart, a patient-level utilization database, and aggregated at the clinic level. SPSS was used to analyze the data and we considered a p-value of less than .05 as statistical significance.

Our research suggests that, while the environmental correlates of resources and governance did impact the time to adoption of the Patient-Centered Medical Home model,

differences in how the model was implemented had mixed results on both preventive and chronic care quality outcomes. The differences in significant measures were small. More research is needed on cost, utilization and patient/provider satisfaction to assess the impact of implementation differences.

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LIST OF ABBREVIATIONS

AAFP	American Academy of Family Practice
ACS	American Cancer Society
AD	Active Duty
AHRQ	Agency for Healthcare Research and Quality
CMS	Center for Medicare & Medicaid Services
CONUS	Contiguous United States
DoD	Department of Defense
DHA	Defense Health Agency
EHR	Electronic Health Record
FOUO	For Official Use Only
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GRIP	Government Recognition Initiative Program
GS	Government Service
HbA1C	Hemoglobin A1C
HEDIS	Healthcare Effectiveness Data and Information Set
LPN	Licensed Practical Nurse
M2	Military Health Mart
MHS	Military Health System
MTF	Military Treatment Facility
NCQA	National Counsel for Quality Assurance
NDP	National Demonstration Project
NP	Nurse Practitioner
OCONUS	Outside Continental United States
PA	Physician’s Assistant

PCMH	Patient-Centered Medical Home
PCPCC	Patient-Centered Primary Care Collaborative
PCT	Primary Care Team
RDT	Resource Dependence Theory
SCT	Structural Contingency Theory

CHAPTER 1: INTRODUCTION

Healthcare spending in the United States has more than doubled since the turn of the century, rising from nearly $1.4 trillion (8.9% of the Gross Domestic Product [GDP]) to right at $3.3 trillion (17.9% of GDP) in 2016 -- more than $10,300 per person (Center for Medicaid & Medicare Services, 2018). While healthcare costs have risen dramatically, improvements in the quality of health care services have not increased at the same rate over the same period (Dartmouth Atlas, n.d.). Studies have found that a greater emphasis on primary care services decreases costs and improves quality outcomes (Donaldson, Yordy, Lohr & Venselow, 1996; Starfield, Shi & Macinko, 2005). Implementation of the Patient-Centered Medical Home (PCMH) model is one way that many health care systems in the United States are seeking to place a greater emphasis on primary care services. PCMH has the potential to further improve the quality of care and reduce costs as well as enhance the patient and provider experience (Arend, Tsang-Quinn, Levine & Thomas, 2012; Baicker & Chandra, 2004; Gill, Landon, Antonelli & Rich, 2010; Stewart et al., 2010).

The PCMH model originated in the pediatric care community in order to consolidate information and care for children with chronic conditions (Sia et al., 2004). Primary care began to adopt similar concepts as the pediatric PCMH model as early as 1978, however, the term medical home did not enter the primary care lexicon until the 1990s in reports from the Institute of Medicine (Arend et al., 2012). It continued to develop with Dr. Ed Wagner's introduction of the chronic care model and was more fully adopted as the future of primary care when the American Academy of Family Practice (AAFP) included it as part of its Future of Family Medicine Project in 2004 (Arend et al., 2012). Finally, in 2006 and 2007 the AAFP and other well-known medical organizations including the American College of Physicians, the American

Academy of Pediatrics and the American Osteopathic Association further refined the definition and endorsed the concept (Arend et al., 2012). The PCMH was defined by these organizations as encompassing seven functions and attributes: personal physician, physician directed medical practice, whole person orientation, coordinated and/or integrated care, quality and safety, enhanced access and payment (Table 1) (Patient-Centered Primary Care Collaborative (PCPCC), 2007).

Table 1: Joint Principles of the Patient-Centered Medical Home

Principle	Definition
Personal Physician	Each patient has an ongoing relationship with a personal physician trained to provide first-contact, continuous, and comprehensive care
Physician-directed medical practice	The personal physician leads a team of individuals at the practice level who collectively take responsibility for the ongoing care of patients
Whole-person orientation	The personal physician is responsible for providing for all the patients' healthcare needs or taking responsibility for appropriately arranging care with other qualified professionals
Care is coordinated and/or integrated	Across all elements of the complex healthcare system (e.g., subspecialty care, hospitals, home health agencies, nursing homes) and the patient's community (e.g., family, public and private community-based services). Care is facilitated by registries, information technology, health information exchange and other means.
Quality and safety	Are hallmarks of the medical home and are achieved by incorporating a care-planning process, evidence-based medicine, continuous quality improvement and performance measurement, information technology, patient-centered care, collection of patient feedback, patient participation in quality improvement activities, and a voluntary medical home recognition process
Enhance access	Care is available through systems such as open scheduling, expanded hours, and new options for communication between patients, their personal physician, and practice staff
Payment	Appropriately recognized the added value provided to patients who have a patient-centered medical home beyond the traditional face-to-face visit

As summarized by Arend et al. (2012) from Joint Principles of the Patient-Centered Medical Home

Though there are now multiple definitions of the PCMH, most organizations agree on the basic principles (Accreditation Association for Ambulatory Health Care, n.d; Joint Commission, n.d; PCPCC, n.d.a). Beyond the basic principles, there is no one 'right' way the model should be structured.

Initial implementation of the PCMH model in primary care began with a National Demonstration Project (NDP) in 2006 in which the model was implemented in 36 different family practices and evaluated over a two-year period (Crabtree et al., 2010). While small improvements were seen in quality of care outcomes the "jury [was] still out on the actual impact on quality of care and patient outcomes" (Crabtree et al., 2010, p. 83).

The model generated additional momentum when it was implemented by larger and larger healthcare systems. Beginning in 2006, Geisinger Health System, located in Pennsylvania and serving more than 2.6 million residents, implemented its own version of the PCMH model, which they called the ProvenHealth Navigator (Geisinger, n.d.). After implementation researchers found reductions in the number of amputations and end stage renal disease, which indicates better healthcare management of chronic disease conditions (Maeng et al., 2012). As the ProvenHealth Navigator has aged it continues to show its value. When evaluating cost savings, Maeng et al., (2015) found a 7.9% decrease in total costs from PCMH implementation in 2006 to the middle of 2013. Their analysis concluded that this reduction was primarily attributable to savings in acute inpatient care (Maeng et al., 2015).

Also in 2006, Group Health, an insurer and health care provider in western Washington, piloted the PCMH model in one of its twenty primary care clinics (Reid et al., 2009). The positive results from this pilot led to the spread of a refined PCMH model to the then 26 Group Health primary care clinics across Washington State and northern Idaho (Reid et al., 2013). In 2008 the Veteran's Health Administration and the Department of Defense (DoD), two of the largest health systems in the nation, also implemented the PCMH model (Marshall et al., 2011).

At the time of our study the DoD Military Health System (MHS) included 56 hospitals, 361 ambulatory care clinics and nearly 150,000 employees (Health.mil, 2014). It spent more than $50 billion annually taking care of its 9.6 million beneficiaries (Health.mil, 2014). The MHS, one of the largest health systems in the United States, began considering the PCMH model in 2008 by developing three pilot projects. These projects included the Navy pilot program at the national Naval Medical Center in Bethesda, Maryland, the Air Force trialing the model at Edwards Air Force Base in southern California and the Army pilot program at the Walter Reed Clinic in Washington D.C. (Christensen et al., 2013; Marshall et al., 2011). A full transition to PCMH began in 2010 (Marshall et al., 2011) with all MHS primary care clinics transitioning to the PCMH model by the end of 2012 and most of the clinics gaining National Committee on Quality Assurance (NCQA) PCMH recognition by 2015. Each branch of the DoD (Army, Navy and Air Force) was required by the MHS to implement PCMH but was given leeway in how they chose to implement it (Marshall et al., 2011).

The Patient-Centered Primary Care Collaborative (PCPCC), a non-profit organization created to advance primary care and the patient-centered medical home (PCPCC, n.d.b), reviews research on the cost and quality outcomes of the PCMH. The February 2016 (Nielsen, Gibson, Buelt, Grundy & Grumbach) report analyzed 17 peer-reviewed studies, 4 state government evaluations and 6 industry reports. The authors found in 21 of 23 studies which reported on cost measures and 23 out of 25 that reported on utilization, that there were indicators of reductions in at least one measure (Nielsen et al., 2016).

Though still not conclusive, the preponderance of evidence appears to indicate that the PCMH model has improved the quality of care and patient outcomes while lowering health care costs. In particular, Nielsen et al. (2016, p. 28), concluded that “the trend…suggests that the longer the PCMH program had been implemented and subsequently evaluated, improvements in cost or utilization were demonstrated.”

CHAPTER 2: ENVIRONMENTAL CORRELATES OF PATIENT-CENTERED MEDICAL HOME IMPLEMENTATION IN THE UNITED STATES MILITARY HEALTH SYSTEM

INTRODUCTION

Although there has been considerable enthusiasm for adopting the PCMH model of care, evaluations of its effectiveness in improving quality and reducing overall costs have shown mixed results ((Arend, Tsang-Quinn, Levine and Thomas, 2012; Maeng et al., 2015; Reid et al., 2013; Stewart et al., 2010). A recent review (Nielsen et al., 2016) continues to suggest considerable promise for the PCMH model in increasing quality and reducing costs in healthcare, and, while not conclusive, the preponderance of evidence appears to indicate a trend in continuing positive results the longer the system has been in place. With the PCMH model beginning to prove its effectiveness, it becomes important to consider what effect environmental correlates have on time to implementation. Since the PCMH model is a relatively new model, most of the research has been empirical and focused on outcomes rather than environmental correlates.

Like other health systems, preliminary results suggest that the PCMH model is having a positive impact on the more than 9 million beneficiaries in the MHS, however little is known about the effect of environmental factors on the time of implementation (Hudak et al., 2013; Uniformed Services Academy of Family Physicians, 2014). With its wide variety of facility sizes and styles of clinics, the MHS provides a suitable model for understanding the effect of environmental factors on time to adoption of PCMH. This study examines the associations between organizational and environmental factors and time to successful adoption of PCMH in the MHS.

THEORY

Resource Dependence Theory (RDT) posits that the environment is made up of organizations with which the primary organization must interact, mainly in exchange relationships to acquire resources (Banaszak-Holl, Zinn & Mor, 1996). An organization will make necessary changes to continue in these exchange relationships, as the relationships are typically necessary for survival (Banaszak-Holl, Zinn & Mor, 1996). RDT is often broken into three constructs—munificence, dynamism and complexity. While dynamism and complexity are most often linked with uncertainty, munificence is concerned with the availability of resources (Yeager et al., 2014).

The environment, and an organization's reaction to that environment, will often affect the performance of that organization. Munificence, or the availability of resources, is an organizational factor that is impacted by the environment in which the organization exists. The availability of resources may have an impact on the performance of an organization, especially when considering the successful adoption of organizational innovation.

Organizational innovation has been defined in multiple ways, from invention to organizational change, but in this instance we will use the definition put forward by Pierce and Delbecq (1977, p. 28) "as the generation, acceptance and implementation of new processes, products or services for the first time within an organization setting." Organizational innovation is an expansive concept that covers many dimensions of change. At its core, organizational change is about improving products, processes or services. It is often related to technology, most likely because technology has been the driving agent for change in many industries over the last century (Kustoff, 2008). In addition to technology, innovation can also incorporate changes in human resource management, structural characteristics in an organization's hierarchy, and improvements in work processes (Gera & Gu, 2004). The PCMH model is an organizational innovation that primarily effects changes in work processes, though it also includes innovations in technology and human resource management. For example, the core principles guiding the MHS implementation of PCMH were:

- Assignment to a personal physician
- Physician-led medical team
- Patient-centered, whole person care
- Care coordination
- Quality and safety
- Improved access
- Payment (Hudak et al., 2013)

While the physician-led medical team is partially a human resource change, most of these principles are changes in the processes or way of doing business.

Successful adoption of innovation has been linked to availability of resources and organizations with greater access to resources are not only more likely to implement innovations but are also more likely to implement those innovations faster than organizations without the same level of access (Pierce and Delbecq, 1977). This leads to the first hypothesis:

Hypothesis 1: Larger organizations will successfully adopt the PCMH model more rapidly than smaller organizations.

Structural Contingency Theory (SCT), first conceptualized by Paul Lawrence and Jay Lorsch in 1967, proposes that there is no one best way for an organization to be organized (Johnson, 2009). Instead, the environment in which the organization exists will determine the best structure for that organization to perform to its fullest extent (Johnson, 2009). How well an organization has conformed to its environment is called fit. More recently Lex Donaldson extended the theory with a variation that suggests that the fit between an organization's structure and its environment can impact performance (as cited by Kim et al., 2014). Van de Ven and Drazin (1984) have also proposed that those organizations that do not have an appropriate fit to their environment will have lower performance.

Unfortunately, the concept of fit within contingency theory has often been poorly defined (Johnson, 2009; Van de Ven and Drazin, 1984). This study utilizes a systems approach to the concept of fit where "fit is the internal consistency of multiple contingencies, structural, and performance characteristics" (Van de Ven and Drazin, 1984, Fig. 1). An organization's structure is made up of both authority and reporting relationships (Kim et al., 2014). This study examines the authority and reporting relationships of the structural command characteristics of the medical branches of the DoD.

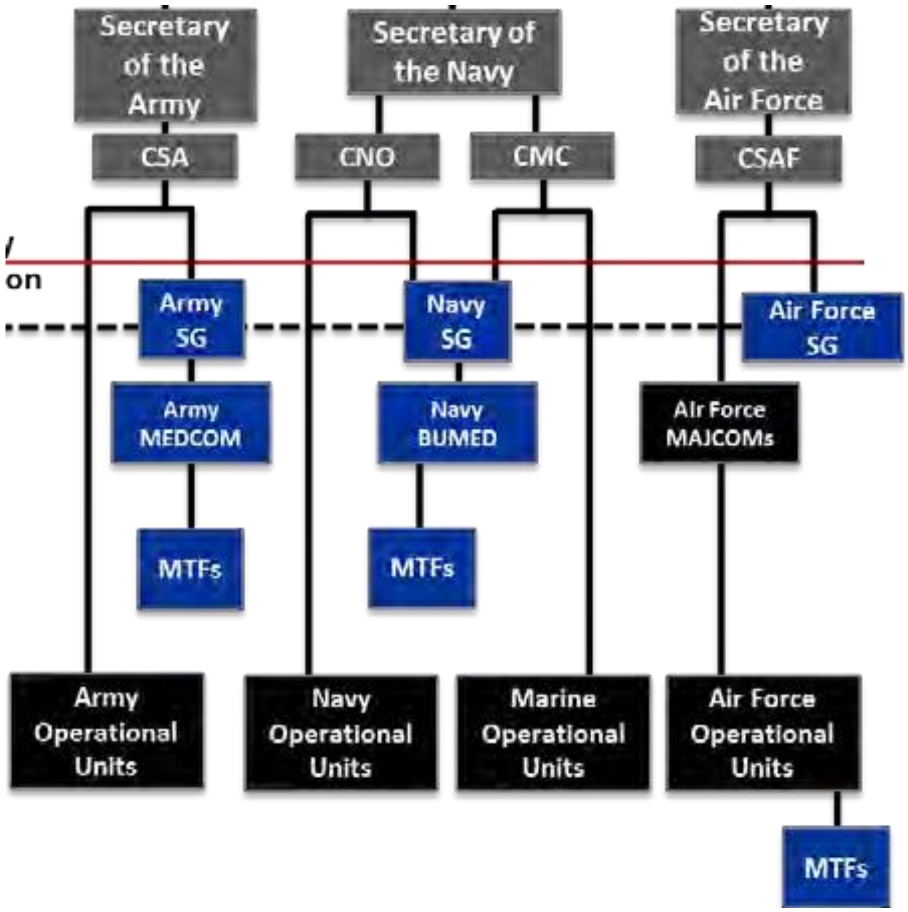
The MHS is one overall unique environment, however the organizational structure of the unique DoD service's health systems is quite different. The Army and Navy have similar structures, with individual Military Treatment Facilities (MTFs) reporting directly to a medical chain of command, which includes both authority and reporting relationships in one line. The Air Force has chosen to go with a different structure where the MTFs do not report directly to the Air Force medical command but to local operational units (Figure 1).

The Air Force structure creates a fragmentation of authority and reporting relationships as they are inexorably entwined in the local political structure due to authority relationships yet are considered separate due to their medical nature. The MTFs have a reporting relationship with the medical command and receive directives from them, such as the directive to implement the PCMH, however, the medical command has no direct authority over them.

Because all three services exist in a similar environment, these differences provide a unique opportunity to examine if the Army/Navy command structure is a better fit to the environment when it comes to successful adoption of organizational innovation. If the Army and Navy truly have a command structure with a better fit, then they will successfully adopt organizational innovations, in this instance the PCMH model, more rapidly.

Hypothesis 2: Facility ownership with a better fit between structure and environment will successfully adopt PCMH more rapidly.

Figure 1: Organizational Structure of the Health Systems of the Department of Defense



LEGEND

___________ Command & Control (C2)

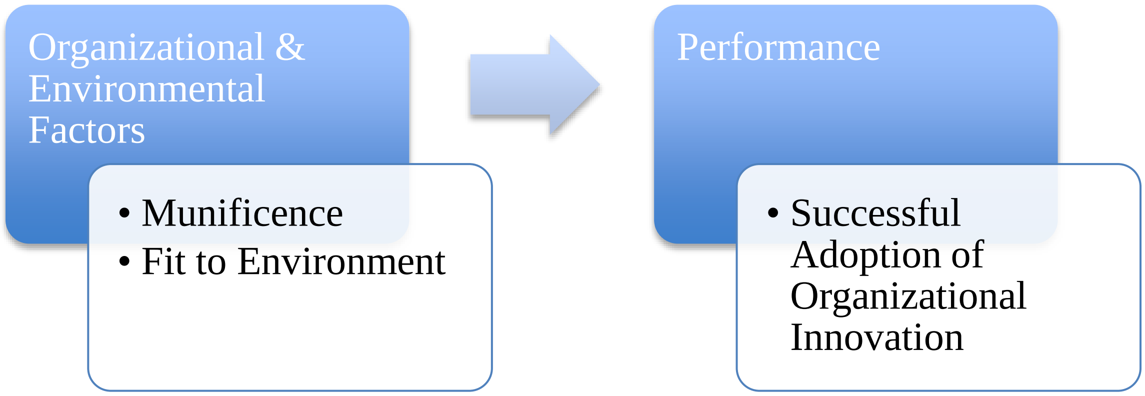
ABBREVIATIONS

BUMED – US Navy Bureau of Medicine and Surgery
CMC – Commandant of the Marine Corps
CNO – Chief of Naval Operations
CSA – Chief of Staff, Army
CSAF – Chief of Staff, Air Force
MAJCOM – Major Command, Air Force
MEDCOM – United States Army Medical Command
MTF – Military Treatment Facility
SG – Surgeon General

(Health.mil, 2014, p. 26)

Combining RDT and SCT allows us to examine both organizational and environmental factors that could affect the successful adoption of the PCMH. The two models together create an overall conceptual model of organizational and environmental factors affecting performance (Figure 2). This study tests each of these hypotheses using data acquired from the MHS.

Figure 2: Overall Conceptual Model of Organizational and Environmental Factors Affecting Performance



Research Question

What impact do the environmental factors of munificence and governance have on the performance of the MHS in implementing PCMH?

LITERATURE REVIEW

Although there are limited studies on the environmental factors that affect the time of implementation, a few have considered organizational and environmental factors when examining the level of readiness for PCMH implementation.

In her recent dissertation, Dr. Anh Nguyen (2014) looked at organizational correlates of readiness to implement PCMH in the Veteran's Administration and found that clinics located in more munificent environments had a higher level of readiness for PCMH model implementation. Rittenhouse et al. (2008) examined the association between organizational size (availability of resources) and PCMH infrastructure where infrastructure is a measure of readiness for PCMH implementation. For the components studied, they found that a positive correlation exists between size and PCMH structure indicating that the facilities that have more available resources are better prepared to implement the entire PCMH model. Goldberg and Mick (2010) used RDT to hypothesize that facilities with more organizational slack (defined as resources in reserve), were more likely to implement the PCMH model. Using a cross-sectional research design with data from the State of Virginia and slack measured as the number of physicians they found slack positively associated with PCMH implementation.

Hollingsworth et al. (2012) investigated the impact of organization size and structure on NCQA PCMH recognition. In this study, they assigned an infrastructure score to a nationwide sample of primary care practices and then compared that score with the NCQA criteria. Using the criteria, they determined whether or not a practice would have gained NCQA recognition and what level of recognition they would have achieved. Multinomial logistic regression was used to evaluate the associations between NCQA levels of recognition and organization size and structure. Consistent with the study by Rittenhouse et al. (2008), Hollingsworth et al. found that size was positively associated with PCMH infrastructure and NCQA recognition. They also found that structure was positively associated with NCQA recognition.

There are many studies that have examined the impact of environmental factors on innovation implementation in both health care and other industries, but none that have investigated the factors that impact the time of implementation using survival analysis (Kimberly & Evanisko, 1981; Damanpour, 1987; Nystrom, Ramamurthy & Wilson, 2002).

METHODS

Study Design

Successful adoption of organizational innovations can be measured in different ways. One way to measure the successful adoption of the PCMH model is to apply a national level of recognition to the PCMH clinic. To ensure all of the services were implementing the same PCMH principles and to be comparable to civilian medical homes, the MHS set the goal “for all…military primary care practices to be recognized as level 2 or 3 PCMHs” by the NCQA (TRICARE, 2015).

The NCQA has become one of the primary PCMH recognition agencies. Others include the Joint Commission, the Accreditation Association for Ambulatory Health Care and the

Utilization Review Accreditation Commission (American Academy of Pediatrics, n.d.). The NCQA, however, has gone a step further by partnering with federal healthcare agencies, specifically with the Health Resources and Services Administration and the Defense Health Agency, in the creation of the Government Recognition Initiative Program (GRIP). While federal facilities are required to meet the same NCQA standards as non-federal facilities, GRIP provides financial support and technical assistance to those facilities seeking recognition (NCQA, n.d.).

To achieve NCQA recognition a medical home has to meet certain "must pass" elements of six standards that align with the core principles of PCMH. These six standards are:

1. Enhance access and communication
2. Plan and Care Management
3. Track and Coordinate Care
4. Identify and Manage Patient Population
5. Provide Self-Care Support and Community Resources
6. Measure and Improve Performance (Marshall et al., 2011)

Medical homes earn additional points for further clinical and service performance. Depending on the number of points earned, a practice will be recognized as Level 1, Level 2 or Level 3 with 3 being the highest (Marshall et al., 2011).

Data and Sample

The sample was drawn from all the PCMH practicing clinics in the MHS with data drawn from the beginning of PCMH implementation at each individual clinic, with the earliest adopters beginning in 2008. The measure begins when the clinic adopts the PCMH model and continues until the event (NCQA PCMH Tier 2 or higher recognition) is achieved or until March of 2015, the cutoff date for the study.

There are 158 MTFs spread across all three services with more than 300 PCMH practicing clinics. Of these, the Air Force operates 72 MTFs with 72 clinics, the Army runs 36

MTFs with 139 clinics and the Navy manages 28 MTFs with 103 clinics. Of the 72 Air Force clinics, 2 were excluded because they had renewed their NCQA recognition and the initial recognition dates were unavailable. Twenty-six of the 70 available Air Force clinics are right censored as they were not NCQA PCMH recognized by March 2015. All 103 Navy clinics have been PCMH NCQA recognized. Although 139 Army clinics have achieved level 2 or 3 NCQA PCMH recognition, 92 clinics were excluded because it was not possible to determine PCMH start dates.

The facilities range in size from several hundred employees to several thousand with corresponding budgets and number of beneficiaries. Because the data are classified by the MHS to be For Official Use Only (FOUO), the actual numbers could not be used in this study. As a result, each MTF was assigned to one of three size categories—small, medium or large.

The clinics that have received NCQA recognition can be found on the NCQA website (http://www.ncqa.org/ReportCards/Clinicians.aspx) and is also available from the Defense Health Agency (DHA) where it is kept to track the status of MHS clinics. PCMH start dates for the individual Navy and Air Force clinics were available from a central source at the respective headquarters level. Unfortunately, the Army did not have one, single office that manages the data and so MTFs were contacted individually. In most cases it had been 4-6 years since PCMH began which led to some difficulties in contacting the MTFs due to the high turnover of personnel in military facilities. First, the contact lists were often out of date. Second, even if it was possible to contact someone, there was often no one in the facility who knew when the clinics had begun PCMH implementation.

Though the number of Army clinics included in the study is less than half of the total number, when combined with the Navy clinics, the sample size is still adequate to test the second hypothesis. A power analysis, which was accomplished using SAS 9.2 utilizing the Lakatos normal approximation method with an effect size of .7, indicated that for ownership a sample size of 65 would produce an actual power of .81, large enough to reduce threats to statistical conclusion validity.

Clinic ownership was not a primary variable for the first hypothesis, however, to achieve a similar power using the same method (Lakatos normal approximation, effect size .7) the minimum sample for the size of the clinics was determined to be 51. This was the driving factor in determining whether a facility was small or medium and influenced the cutoff point between small and medium facilities.

The data have been classified as non-human subjects research by an Institutional Review Board.

Measures

The construct for the first hypothesis is munificence with a variable of facility size (Table 2). Facility size was operationalized as the number of Full Time Equivalent (FTE) employees. Because the exact number of employees was classified as FOUO, the numbers are not included in the study. Instead, the numbers were used to assign each facility to one of three categories—small, medium or large—depending on the number of employees. The small category included all MTFs with less than 370 FTEs, the medium included MTFs with actual FTEs of between 370 and less than 1,000 and the large category included all MTFs with 1,000 or more actual FTEs. The clinics were then categorized by their parent MTF. In the end, there were 51 clinics belonging to small MTFs, 59 classified as medium size MTFs and 115 belonging to large MTFs. A chi-square test indicates that there was a significant association between size and ownership ($p<.05$).

Table 2: Ownership of Facility by Size

	Air Force	Army	Navy	Total
Small	45	0	6	51
Medium	18	6	35	59
Large	7	44	62	113
Total	70	50	103	223

Success of PCMH adoption was measured as the number of months between the beginnings of PCMH implementation and when the facility achieved Level 2 or higher NCQA recognition. This is known in survival analysis as the time to event. The MTFs had a staggered entry as they did not all begin PCMH at the same time. The data are right censored, as there are some facilities that have not yet achieved NCQA PCMH recognition.

The successful adoption of organizational innovation variable—time to NCQA Level 2 or higher recognition--was the same for the second hypothesis, however the construct of Fit to Environment with the variable of facility ownership was operationalized by placing the facility in one of two groups. The first group, which is the comparison group, included the Army and Navy clinics while the second group consisted of Air Force clinics.

Statistical Analysis

SPSS Version 23 was used to analyze the data. First, Kaplan-Meier survival analysis was executed to compare the time to event experience of the different groups and whether the differences were statistically significant. The first hypothesis was tested using Cox proportional hazards regression (survival analysis). Originally, we adjusted for the covariate of facility ownership but found that there was no statistical significance. The dependent variable is time to the event (NCQA PCMH recognition) and the independent variables are the size of the clinic—small, medium or large.

The second hypothesis was also tested using Cox proportional hazards regression (survival analysis). Again, adjusting for the covariate of facility size was unnecessary as the covariate was not statistically significant. The dependent variable is the time to the event, while the independent variable is the ownership of the individual clinic (i.e., whether they are Army/Navy or Air Force).

RESULTS

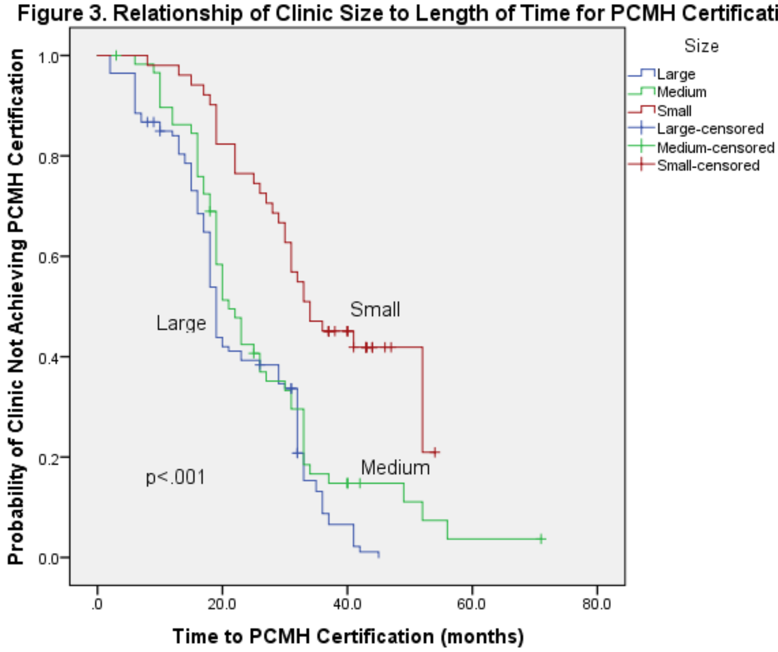
Of the 223 clinics included in the data set 186 (83.4%) received NCQA recognition by March of 2015 while 37 (16.6%) did not. Kaplan-Meier survival analysis was used to compute the median survival time (Table 3) with the overall median for all clinics being 23 months. The median time for large clinics was 2 months less than for medium clinics and 15 months less than for small clinics. There was a 15-month difference in median survival times between the Army/Navy and Air Force groups.

Table 3: Median Survival Time (Months)

	Army/Navy	Air Force	Overall
Small	22	41	34
Medium	19	31	21
Large	19	17	19
Overall	19	34	23

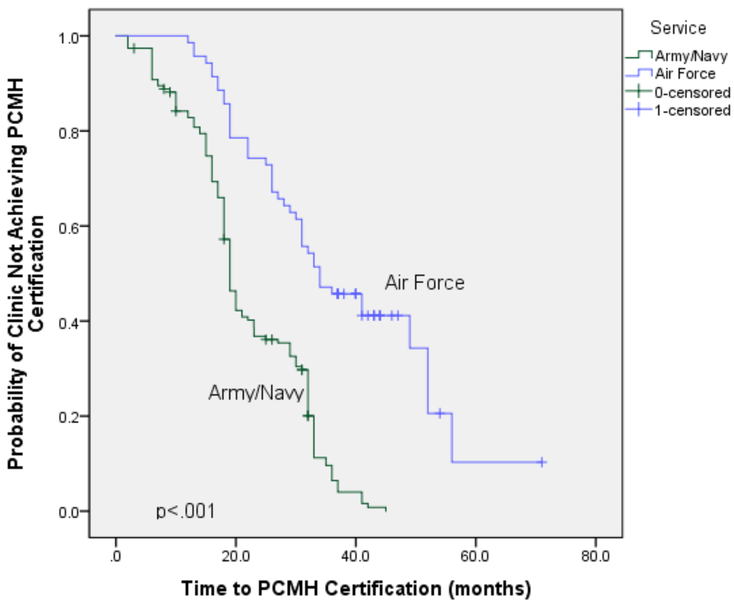
Kaplan-Meier survival curves (Figure 3 & 4) were created and the Log-Rank test was done to compare the differences between the groups.

Figure 3. Relationship of Clinic Size to Length of Time for PCMH Certification



With a p value of less than .001, we conclude that there is a statistically significant difference between the three groups by size. The Cox Proportional Hazards Model (Table 4) indicates that the hazard to get PCMH certified for medium size facilities is 3.14 times higher than in large facilities (p<.001, 95% Confidence Interval (CI) 2.08 to 4.74), and for small facilities is 2.31 times higher than in large (p<.001, 95% CI 1.47 to 3.65).

Figure 4: Relationship of Clinic Ownership to Length of Time to PCMH Certification



The Kaplan-Meier survival curves in Figure 4 show an even greater difference between the clinics belonging to the Air Force and those belonging to the Army and Navy. This difference was also found to be statistically significant (p<.001). The Cox Proportional Hazards model (Table 4) found the hazard to get PCMH certified for the Air Force was 3.38 times higher than for the Army/Navy (p<.001, 95% CI 2.35 to 4.88).

Table 4: Result of Cox's Proportional Hazards Analysis for Size and Ownership of MTFs

Explanatory Variables	Hazard Ratio	95% Confidence Interval	Sig
Small Facility	2.31	1.47, 3.65	<.001
Medium Facility	3.14	2.08, 4.74	<.001
Air Force	3.38	2.35, 4.88	<.001

DISCUSSION

The study results support the hypotheses--munificence appears to have had a significant impact on the time to adoption of this organizational innovation. The larger facilities, with presumably greater resources, successfully adopted the PCMH model significantly more rapidly than the smaller organizations, though looking at the survival curves it is apparent that the gap between the large and medium facilities was smaller. This finding is in line with previous research documenting the level of resources on PCMH implementation, though these findings are specific to time to implementation rather than overall implementation.

Because the MHS is primarily a closed system and does not have to compete for resources on the open market, it may be advantageous for senior leaders to ensure that smaller facilities have more resources if the expectation is that organizational innovations will be adopted at a similar rate. Once resources are appropriated by the U.S. Congress the MHS has the authority to determine how and where the funds should be allocated. However, the findings appear to show that this reallocation of resources may not be possible. Even in a closed system such as the MHS, the results support that munificence, or the scarcity of resources, has an impact.

The second hypothesis is also supported by the findings—facility ownership did make a difference in how rapidly PCMH was adopted. Specifically, the Army and Navy’s governance structure appears to be a better fit to the environment. This better fit allowed their facilities to successfully adopt PCMH more rapidly. This finding provides some useful insights into the potential impact of future innovations and the difficulties faced by the Air Force Medical Service with its fragmented command structure. The finding also appears to support Donaldson’s theory (as cited by Kim et al., 2014) that the fit between an organization’s structure and its environment can impact its performance as well as Van de Ven and Drazin’s (1984) proposal that organizations that differ from the ideal will have lower performance.

Though the research results support the second hypothesis, additional research is needed to assess other organizational innovations to see if it continues to hold true. While it would be good to continue to test the hypothesis, it may be even more important to conduct additional research on the fit to structure and its possible impact on other performance areas in the AFMS. If the fit to structure is impacting other performance areas, this could have significant policy implications. Specifically, if the poor fit to structure continues to hold true, it may be time to consider modeling the AFMS after the Army and Navy model of a centralized health command.

The primary limitation of this study is that it not possible to prove causation with a correlational study. Omitted variable bias--leaving out important, usually unknown, variables--is an inherent weakness in correlational studies. For example, there could be some other confounding factor such as an unrecognized difference between the groups. Other previously mentioned limitations include the difficulty in collecting data, which led to the exclusion of many Army clinics, and the right censoring, which primarily effected Air Force clinics. While the power analysis indicated that there were enough clinics in the sample to provide statistically sound data analysis, there may have been some unknown variable missed within the subset of excluded Army clinics.

Another limitation is that NCQA recognition may not adequately represent successful adoption of the PCMH model. In a policy brief in the May-June 2014 issue of The Journal of the American Board of Family Medicine, Hahn, et al., (2014) explained their findings after interviewing high functioning, innovative practices. They found that nearly half of the clinics interviewed did not pursue recognition and, of those that did, they often did so in pursuit of financial incentives and not due to a belief that it would lead to higher quality care (Hahn, et al., 2014). Similarly, Dohan et al., (2013) did a case study of a medical group that achieved recognition and then decided not to renew as there did not appear to be any financial incentive due to lack of enthusiasm from payers. Dr. William Miller (2014) suggested that NCQA recognition criteria are too specific in a time when the best practices are still unknown. In his opinion, PCMH recognition should not be about setting standards but should recognize those clinics that are best leading in innovation that leads to results (Miller, 2014).

While the MHS has many similarities to health care systems in the private sector, it does have significant differences especially in how it is financed and how the beneficiaries are brought into the system. Because of these differences, the findings may not be generalizable to other health care systems.

CONCLUSION

The analysis confirmed the hypothesis that the availability of resources has a major impact on how rapidly organizations adopt new innovations. More importantly, it also identified that the AFMS has a poor fit to structure when compared to the Army and Navy's adoption of the PCMH model.

It would be useful to know whether this poor fit is only for this organizational innovation or whether it is more widespread. If the poor fit between the organization and environment is found in other organizational behaviors such as quality outcomes, strong consideration should be given to making organizational changes to improve the fit to the environment. Future research should begin by looking at other organizational innovations to determine if the fit is similar in other instances.

This research is also applicable to other organizations—a poor fit to the environment of the organization can lead to longer innovation adoption times. An organization should consider how they fit in their environment before they adopt new innovations. If they differ from the ideal, they should consider ways to improve their fit to enhance their performance.

CHAPTER 3: EXAMINING THE EFFECT OF PATIENT-CENTERED MEDICAL HOME ON PREVENTIVE CARE MEASURES IN THE MILITARY HEALTH SYSTEM

INTRODUCTION

In 2014 Dr. William Miller argued that it was too early in the PCMH implementation process to know what should and should not be nationally recognized. He suggested that we did not yet know what the best practices for PCMH look like and that they were, in fact, “still emerging and being invented” (Miller, 2014 p. 309). Since that statement, there has been a steady release of evidence indicating that the PCMH model does produce a positive impact on the quality of care while also lowering health care costs (Nielsen et al., 2015; Nielsen et al., 2016; Fund, 2017). However, best practices, in many instances, have yet to be identified.

Research on the PCMH model has identified some common practices and processes (e.g., regularly analyzing Electronic Health Record (EHR) data, focusing on frequent users of the emergency department, developing an individual patient care plan, and improving care coordination with behavioral health and dental health professionals) that improve quality and patient outcomes. For instance, Maeng et al. (2015) found that in the Geisinger Health System, PCMH cost savings were largely attributable to reduction in acute inpatient care. While studies have shown the efficacy of the model, no study has yet examined the impact of PCMH team composition on patient outcomes. With the passage of the Medicare Access and CHIP Reauthorization Act (MACRA) of 2015, the Centers for Medicare & Medicaid Services (CMS) appear to be pushing providers toward the implementation of alternative delivery models such as PCMH by focusing on quality outcomes as the primary driver of payment formulation (CMS, n.d.; PCPCC, n.d.c). This legislation makes understanding the impact of variations in team composition on outcomes valuable to healthcare administrators seeking to implement the PCMH model in any setting.

The importance of the Primary Care Team (PCT) to the PCMH Model has been well documented (Agency for Healthcare Research and Quality (AHRQ), n.d.; Bendix, 2013, Grumbach & Bodenheimer, 2004; Stout et al., n.d.). Recommendations for which professionals should be on the physician led team typically include advance practice professionals such as physician's assistants and nurse practitioners, registered nurses, medical assistants, pharmacists, mental health professionals and social workers (AHRQ, n.d.). However, there is no agreement on what the final composition of the team should be (Fierce Healthcare, 2012). Though the principles of PCMH such as care coordination, improved access and the physician-led medical team have been defined by multiple organizations (Accreditation Association for Ambulatory Health Care, n.d; Joint Commission, n.d; Patient-Centered Primary Care Collaborative, n.d.b), there is no one accepted definition of PCT. This provides flexibility for each medical practice to implement PCMH in the way that best works for them (Marshall et al., 2011)

This open-ended definition has provided little guidance or research on the actual composition of the team. As PCMH implementation is typically standardized across an organization it is difficult to study differences in PCTs. The MHS provides a unique opportunity to study the impact of PCMH team composition because of the way the PCMH model has been implemented across the various military branches.

The MHS began considering the PCMH model in 2008 by developing three pilot projects. These projects included the Navy pilot program at the national Naval Medical Center in Bethesda, Maryland, the Air Force trialing the model at Edwards AFB in southern California and the Army pilot program at the Walter Reed Clinic in Washington D.C. (Christensen et al., 2013; Marshall et al., 2011). A full transition to PCMH began in 2010 (Marshall et al., 2011) with all MHS primary care clinics transitioning to the PCMH model by the end of 2012 and most of the clinics gaining NCQA PCMH recognition by 2015. Each branch (Army/Navy/Air Force) of the DoD was required by the MHS to implement PCMH but was given latitude about how it should be implemented and what the PCT composition should be (Marshall et al., 2011).

The Air Force model was initially called the Family Health Initiative but was later rebranded as the Air Force Patient-Centered Medical Home (Hudak et al., 2013). PCTs were created that consisted of two primary care providers (most often a physician and either a physician's assistant (PA) or a nurse practitioner (NP)), a nurse and five medical technicians (Marshall et al., 2011). Additional team members were assigned to assist all teams, which included disease management nurses, case management nurses, a health interrogator and a group practice manager (Marshall et al., 2011).

The Army model, known as the Army Home, created practice level PCMH teams that included a primary care provider, a nurse, one and a half care coordinators and two medical technicians. The teams also had additional specialists at the clinic level such as a group practice manager, a case management nurse, a pharmacist, two lab technicians, a behavioral health specialist and an extra provider who could fill in when one of the team providers was absent (Hudak et al., 2013; Marshall et al., 2011).

The Navy branded their PCMH as the Medical Homeport (Hudack et al., 2013). The initial teams were larger than either the Air Force or Army teams with 4 primary care providers (a mixture of physicians, PAs and NPs), 2 nurses, 1 licensed practical nurse (LPN), 9 medical technicians and 1 administrative support person (Marshall et al., 2011).

Table 5: Patient Care Team Composition by Military Branch

	Providers	Nurses	Medical Technicians	Other Medical Personnel
Army	1	1	2	Shared
Navy	4	2	9	1 LPN, 1 Admin
Air Force	2	1	5	Shared

While research results indicate that the PCMH model is positively impacting the more than 9 million beneficiaries in the MHS, little is known about how the differences in PCMH approach have affected preventive care outcomes (Hudak et al., 2013; Uniformed Services Academy of Family Physicians, 2014). In this study we seek to examine how different approaches to PCMH implementation by the Army, Navy and Air Force can impact the quality of care. We hypothesized that the independent development of PCMH models and team composition by the Army, Navy, and Air Force might lead to important differences in preventive care quality measures of PCMH success.

METHODS

Data and Sample

We used a pooled cross-sectional research design with secondary data to assess the impact of PCMH on four clinical quality measures. The measures were taken from those suggested by Rosenthal, Abrams, Bitton and The Patient-Centered Medical Home Evaluators' Collaborative in their 2012 data brief titled "Recommended Core Measures for Evaluating the Patient-Centered Medical Home: Cost, Utilization and Clinical Quality." These measures include Breast Cancer Screening, Cervical Cancer Screening, Chlamydia Screening and Colorectal Cancer Screening. Once the measures were identified, the data was pulled from the Military Health Mart (M2) and aggregated at the clinic level with the PCMH clinic as the primary unit of interest.

The sample was based on data drawn from all the PCMH practicing clinics in the MHS for each calendar year from 2010 to 2014. There are 158 MTFs spread across all three services with more than 300 PCMH practicing clinics. Of these, the Air Force operates 72 MTFs with 72 clinics, 36 MTFs with 139 clinics are run by the Army and the Navy manages 28 MTFs with 103 clinics. Clinics share a parent-child relationship with the MTF. For the Air Force there is only one PCMH clinic at each MTF, however, the Army and Navy, with larger bases and increased number of personnel, often have multiple PCMH clinics at their MTFs. In some instances, these clinics are co-located but they can also be in separate buildings or even Off-base within the local community.

The quality measures were drawn from a patient-level utilization database managed by the MHS (M2). The data consisted of 1,745 total records for each of the primary measures. All clinics with 20 or less eligible beneficiaries were removed because the dependent variable is a percentage and the smaller clinics would be likely to introduce bias into the final results. After this adjustment was made, the final number of records ranged from 1,298 (Colorectal Cancer Screening) to 1,630 (Cervical Cancer Screening). The extreme variability in these numbers can be explained by understanding the demographics of the patient population seen by the clinics in the MHS. PCMH clinics are primarily focused on Active Duty military members who typically range in age from 18 to 45 along with their dependent family members. Though retirees can be, and often are, treated in PCMH clinics, they also have the option to be seen at non-military clinics, which may be closer to their home. Thus, there are more records for Cervical Cancer Screening as it applies to the entire female population than for Colorectal Cancer Screening because it will be applied to a much smaller proportion of the population.

The data were analyzed using SPSS Version 24 and significance levels were assumed at p values less than .05.

Measures

Screenings are frequently used as indicators to measure the quality of preventive medicine in a PCMH. Our dependent variables (Table 6)--Breast Cancer Screening, Cervical Cancer Screening, Chlamydia Screening and Colorectal Cancer Screening--have been used in multiple PCMH studies (Friedberg et al., 2015; Hu et al., 2018; Kern, Edwards & Kaushal, 2014; Nelson et al., 2014; Solberg et al., 2011) and are included in the NCQA's Healthcare Effectiveness Data and Information Set (HEDIS).

Screening outcomes were assessed for each clinic on December 31 of each calendar year included in the study. Outcomes were measured for each of the four screening tests by the proportion of patients assigned to the clinic who were up-to-date on each of the tests.

Table 6: Independent and Dependent Variables for Preventive Care

Name	Description		Type
Breast Cancer Screening	Percentage of women ages 40-69 who had a mammogram to screen for breast cancer	Continuous	Primary Dependent
Cervical Cancer Screening	Percentage of women ages 21-64 who received one or more Pap tests to screen for cervical cancer	Continuous	Primary Dependent
Chlamydia Screening	Percentage of women ages 16-24 who were identified as sexually active and who had at least one test for chlamydia during the measurement year	Continuous	Primary Dependent
Colorectal Cancer Screening	Percentage of members ages 50-75 who had appropriate screening for colorectal cancer	Continuous	Primary Dependent
Branch of Service	Army, Navy, Air Force	Categorical	Primary Independent
Pre-Post Assessment	Pre: 2010-11, Post-2012-2014	Categorical	Primary Independent
Differences-in-Differences Estimator (interaction)	Interaction between branch of service and Pre-Post Assessment	Categorical	Primary Independent
CONUS vs. OCONUS	Contiguous United States vs. Overseas	Categorical	Secondary Independent
On-base vs. Off	Clinic located On-base or Off-base	Categorical	Secondary Independent
Size	By FTE; Large>999; Medium=370-999; Small<370	Categorical	Secondary Independent
Primarily Active Duty (AD) Patients	Not Primarily AD (<90% AD patients); Primarily AD (≥90% AD patients)	Categorical	Secondary Independent

The denominator of this proportion consists of patients who fit the risk profile for whom screening is recommended by the relevant practice guideline. The numerator consists of patients who had the appropriate screening test done within the time frame defined by the guideline. Because the military uses a common, shared EHR across all practice sites, whether a patient is up-to-date at a given clinic location can be determined accurately even if the screening occurred in a different military facility.

The MHS follows American Cancer Society (ACS) guidelines for cancer screening. Breast Cancer and Colorectal Cancer Screening guidelines were constant over the period of interest, though Breast Cancer Screening recommendations changed in 2015. From 2003 to 2015 the ACS recommended that women 40 and older receive an annual Mammogram (ACS, 2018) and this is the standard we used for our measure. Cervical Cancer guidelines changed in 2012 from an annual Pap test to one every three years (ACS, 2018). For our measure we used the new guideline for all years of the study by identifying the percentage of women ages 21-64 that received a Pap test in the last 3 years. The U.S Preventive Services Task Force recommends Chlamydia Screening for all sexually active women age 24 and younger (U.S. Preventive Services Task Force, 2016) though our measure contained only women ages 16-24 that were identified as sexually active. Measures were calculated by dividing the total number of those screened by the total number eligible for the screening.

Facilities ranged in size from several hundred employees to several thousand with corresponding budgets and number of beneficiaries. Because the MHS considers the data to be FOUO, the actual numbers could not be used in this study. As a result, each MTF was assigned to one of three size categories—small, medium or large--as determined by the number of FTE employees. The large category included all MTFs with 1,000 or more FTEs, the medium category of MTFs had between 370 and 999 FTEs, while the small category consisted of all MTFs with less than 370 FTEs.

While the majority of MHS PCMH clinics are primarily manned by active duty personnel, including providers, nurses, medical technicians and administrative personnel, there are several MHS clinics that are primarily manned by civilian personnel. These personnel are either Government Service (GS) or contracted. The civilian manned clinics tend to be located off-base. To capture the effect of these clinics on quality measures we created a binary variable on whether the clinics were manned primarily by civilian personnel.

Statistical Analysis

To evaluate the impact of PCMH implementation in the various branches of military service on preventive care quality outcomes we used univariate, bivariate and linear multivariate regression analysis as well as differences-in-differences analysis, a quasi-experimental study design that is frequently used to determine associations after policy changes (Rajaram et al., 2014). Differences-in-differences models were created to compare quality outcomes in PCMH clinics by branch of service before and after PCMH implementation. The dependent variable in each model was the quality measure and the primary independent variables were the branch of service, a pre-post assessment and the interaction between the branch of service and the pre-post assessment (Table 6). Other independent variables included the size of the parent facility, whether the clinic is located On-base or off, whether the clinic is in the Contiguous United States (CONUS), 48 states excluding Alaska and Hawaii, or Outside Continental United States (OCONUS) including Alaska and Hawaii and, finally, whether the clinic saw primarily active duty (AD) patients (≥90%).

Differences-in-differences is typically used with a control group to analyze the effect of an intervention. Because all the branches of service incorporated PCMH at roughly the same time, our intervention is the implementation of the PCMH model with differences-in-differences adjusting for other unmeasured variables that would affect all branches of service similarly. The basic differences-in-differences equation includes two dummy variables, one for the control and treatment groups and the other for the pre-post assessment. It also includes an interaction term between the two dummy variables with the equation appearing as:

$$Y=b_0+b_1x_1+b_2x_2+b_3x_1x_2$$

Because we have three groups we gain an additional dummy variable as well as an additional interaction term modifying our base equation to:

$$Y=b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_1x_3+b_5x_2x_3$$

Where x_1 will be Navy, x_2 is Air Force and x_3 is our time variable. The interaction terms are our differences-in-differences estimators with the coefficients indicating the extent of association between the branch of service and the dependent variable.

RESULTS

Descriptive statistics were calculated for the clinics by branch of service (Table 7) as well as for the dependent variables (Table 8). Data points (clinic-year) ranged from 1,529 for the Air Force to 2,193 for the Army. The Air Force had a little more than one-fourth of total Pre and Post

(26.4%) outcomes with the Army and Navy accounting for slightly more than one-third for each, ranging from 35.4% (Navy, Post) to 38.8% (Army, Post).

Table 7: Descriptive Statistics of Clinics for Preventive Care

Characteristic	Army	Navy	Air Force
N	2193	2077	1529
Pre	37.2%	36.5%	26.4%
Post	38.8	35.4	26.4
Large	52.3	41.5	6.2
Medium	27.0	41.1	31.9
Small	13.6	16.0	70.4
On-base	35.7	36.2	28.1
Off-base	69.2	29.7	1.1
CONUS	37.2	36.5	26.3
OCONUS	40.1	33.4	26.5
Not Primarily AD	37.0	31.8	31.2
Primarily AD	41.8	55.0	3.2

The Air Force had the largest number of small clinics (70.4%) but only a few large clinics (6.2%) while the Army and Navy were roughly equal in small clinics (13.6% and 16.0%). A little more than half of all large clinics belonged to the Army (52.3%) and the Navy had the largest percentage of medium clinics (41.1%). Most of the off-base clinics were operated by the Army (69.2%) while there were almost no off-base clinics (1.1%) operated by the Air Force. Overseas (OCONUS) clinics were more evenly distributed. For these clinics, the corresponding percentages in the Army, Navy and Air Force were 40.1%, 33.4% and 26.5%. The Navy has the most Primarily AD clinics (55.5%) while the Air Force has almost no Primarily AD clinics (3.2%).

There were between 1,298 and 1,630 data points for each of the dependent variables with the data points nearly evenly distributed between the branches of service (Table 8). More than half of all dependent variable data points came from clinics belonging to a large MTF and over 93% were from on-base clinics while approximately 80% were from CONUS clinics. Average screening rates ranged from 63.7% (SD: 12.1%) for Chlamydia Screening to 86.5% (SD: 6.9%)

for Cervical Cancer Screening. Both Breast and Colorectal Cancer Screening were about 73%, though Breast Cancer had a higher standard deviation (9.0% vs. 7.5%).

Table 8: Descriptive Statistics of Key Variables for Preventive Care

	Breast Cancer Screening	Cervical Cancer Screening	Chlamydia Screening	Colorectal Cancer Screening
N	1304	1630	1567	1298
Mean	73.1%	86.5%	63.7%	73.1%
Standard Deviation	9.0	6.9	12.1	7.5
Median	73.8	86.0	62.8	73.3
Army	38	38	37	39
Navy	33	38	38	33
Air Force	29	24	25	28
Large	54	55	54	54
Medium	23	24	25	23
Small	23	21	21	23
On-base	93	94	94	93
Off-base	7	6	6	7
CONUS	79	77	77	81
OCONUS	21	23	23	19
Not Primarily AD	91	76	78	88
Primarily AD	9	24	22	12

We conducted sensitivity analysis over several steps beginning with a bivariate linear regression analysis by branch of service (Table 9). We found that, at this level, the Navy and Air Force were significantly different from the Army for all dependent variables. The Air had significantly smaller screening rates than the Army, ranging from a difference of 3.3% (Colorectal Cancer Screening) to 7.4% (Chlamydia Screening), for all variables. The Navy was less than the Army for Chlamydia (1.5%) and Colorectal Cancer Screenings (2.5%) but significantly greater than the Army for Breast Cancer Screening (1.2%) and Cervical Cancer Screening (1.0%).

We continued with a bivariate linear analysis of each of the dependent variables by the Pre- and Post-PCMH variable with time variables defined as Pre-PCMH (2010-11) and Post-PCMH (2012-14).

Table 9: Bivariate Analysis of Preventive Care Measures by Branch of Service

	Army			Navy			Air Force		
Measure	Mean	95% CI	Sig	Mean	95% CI	Sig	Mean	95% CI	Sig
Breast Cancer	74.3%	73.6, 75.1	<.001	75.5%	74.4, 76.6	.036	68.7%	67.6, 69.9	<.001
Cervical Cancer	87.7	87.3, 88.2	<.001	88.7	88.0, 89.4	.005	81.1	80.3, 81.9	<.001
Chlamydia	66.1	65.1, 67.1	<.001	64.6	63.3, 66.0	.031	58.7	57.2, 60.3	<.001
Colorectal Cancer	74.8	74.2, 75.4	<.001	72.3	71.4, 73.2	<.001	71.5	70.6, 72.3	<.001

We found that the Post-PCMH period was significantly different from the Pre-PCMH period for all variables (Table 10). The differences between Pre- and Post-PCMH for Cervical Cancer Screening (-2.9%) and Chlamydia Screening (-4.6%) were significant while differences for Breast Cancer Screening (1.4%) and Colorectal Cancer Screening (2.7%) were significantly higher in the Post- vs. Pre-PCMH periods.

Table 10: Bivariate Analysis of Preventive Care Measures by Pre-Post PCMH

	Pre			Post		
Measure	Mean	95% CI	Sig	Mean	95% CI	Sig
Breast Cancer	72.3	71.5, 73.0	<.001	73.7	72.7, 74.7	.004
Cervical Cancer	88.3	87.8, 88.8	<.001	85.4	84.7, 86.1	<.001
Chlamydia	66.5	65.6, 67.4	<.001	61.9	60.7, 63.1	<.001
Colorectal Cancer	71.3	70.7, 71.9	<.001	74.0	73.3, 74.8	<.001

In the next step, we performed a multivariate analysis for each of the dependent variables stratified by the branch of service (Tables 11-13). The tables show the coefficient as a percent (%) relative to a comparison group. For the Army, significant results in Breast Cancer Screening were found in the Medium vs. Large Clinics with Medium Clinics 3.8% less than Large Clinics and OCONUS Clinics 7.5% less than CONUS Clinics (Table 11). Post-PCMH was significantly different from Pre-PCMH for the other three dependent variables, however it was significantly less for Cervical Cancer Screening (3.3%) and Chlamydia Screening (5.4%) but significantly greater for Colorectal Cancer Screening (5.0%). Medium Clinics were significantly less than Large Clinics for both Chlamydia (2.7%) and Colorectal Cancer Screenings (1.7%) but Small Clinics were only significantly different, and in the other direction, for Colorectal Cancer Screening (2.9%).

Off-base clinics were only significantly different for Cervical Cancer Screenings (1.5% greater). OCONUS Clinics were significantly greater than CONUS Clinics for both Cervical Cancer Screening (3.7%) and Chlamydia Screening (6.5%) but less for Breast Cancer Screening (7.5%). Finally, Clinics that saw primarily AD patients were significantly greater than those that did not see primarily AD patients for all variables ranging from 4.6% (Colorectal Cancer Screening) to 19.6% (Chlamydia Screening).

For the Navy, all Post-PCMH variables were significantly different from Pre-PCMH with Breast Cancer Screening (1.7%) and Colorectal Cancer Screening (2.5%) significantly greater in the post period while Cervical Cancer Screening (2.7%) and Chlamydia Screening (4.3%) were significantly less (Table 12). The size of the facility was only significant for Cervical Cancer Screening (2.9%) and Chlamydia Screening (2.9%) when comparing Medium to Large and Colorectal Cancer Screening (3.1%) for Small to Large and all were significantly less.

Off-base clinics were significantly greater than on-base clinics for Breast Cancer Screening (5.4%) but significantly less for Cervical Cancer Screening (3.7%) and Chlamydia Screening (7.4%). OCONUS Clinics were significantly greater than CONUS clinics for Breast Cancer Screening (3.7%), Cervical Cancer Screening (3.9%), and Chlamydia Screening (4.1%). Primarily AD Clinics were significantly greater for Cervical Cancer Screening (8.2%) and Chlamydia Screening (12.1%) but less for Colorectal Cancer Screening (3.3%).

Table 11: Multivariate Linear Regression Analysis of Preventive Care Measures by Army

	Breast Cancer			Cervical			Chlamydia			Colorectal		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Pre	Ref			Ref			Ref			Ref		
Post	.2	-1.2, 1.6	.759	-3.3	-4.0, -2.6	<.001	-5.4	-7.0, -3.8	<.001	5.0	3.8, 6.2	<.001
Large	Ref			Ref			Ref			Ref		
Medium	-3.8	-5.7, -2.0	<.001	-.9	-1.8, <.01	.056	-2.7	-4.8, -.6	.011	-1.7	-3.4, -.1	.040
Small	-2.3	-4.8, .2	.074	-.9	-2.2, .4	.187	1.4	-1.7, 4.5	.384	2.9	.7, 5.0	.010
On-base	Ref			Ref			Ref			Ref		
Off-base	-2.1	-4.3, <.01	.052	1.5	.4, 2.7	.011	-2.4	-5.1, .2	.075	.7	-1.2, 2.6	.466
CONUS	Ref			Ref			Ref			Ref		
OCONUS	-7.5	-9.1, -5.8	<.001	3.7	2.9, 4.6	<.001	6.5	4.6, 8.4	<.001	.3	-1.1, 1.8	.669
Not Primarily AD	Ref			Ref			Ref			Ref		
Primarily AD	8.4	6.4, 10.4	<.001	10.1	9.3, 10.9	<.001	19.6	17.7, 21.5	<.001	4.6	2.9, 6.3	<.001

Table 12: Multivariate Analysis of Preventive Care Measures by Navy

	Breast Cancer			Cervical			Chlamydia			Colorectal		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Pre	Ref			Ref			Ref			Ref		
Post	1.7	.2, 3.2	.025	-2.7	-3.4, -2.0	<.001	-4.3	-5.8, -2.7	<.001	2.5	1.0, 4.1	.001
Large	Ref			Ref			Ref			Ref		
Medium	-1.0	-2.8, .8	.267	-2.3	-3.2, -1.5	<.001	-2.9	-4.7, -1.0	.002	-1.3	-3.2, .5	.145
Small	<.1	-2.5, 2.6	.987	-1.0	-2.2, .2	.094	<.1	-2.6, 2.7	.991	-3.1	-5.8, -.5	.022
On-base	Ref			Ref			Ref			Ref		
Off-base	5.4	2.3, 8.5	.001	-3.7	-5.5, -1.9	<.001	-7.4	-11.2, -3.5	<.001	-1.1	-4.3, 2.1	.490
CONUS	Ref			Ref			Ref			Ref		
OCONUS	3.7	1.8, 5.6	<.001	3.9	3.0, 4.8	<.001	4.1	2.2, 6.1	<.001	-.7	-2.8, 1.4	.516
Not Primarily AD	Ref			Ref			Ref			Ref		
Primarily AD	.2	-2.1, 2.5	.872	8.2	7.5, 8.9	<.001	12.1	10.5, 13.8	<.001	-3.3	-5.3, -1.3	.001

Diff – Absolute percent difference from the reference group

The post period was significantly different from the pre-period for all Air Force Clinics with Breast Cancer Screening (3.0%) and Colorectal Cancer Screening (2.1%) greater Post-PCMH and Cervical Cancer Screening (2.8%) and Chlamydia Screening (4.2%) less (Table 13). Medium Clinics were significantly different from Large Clinics for all but Chlamydia screening. Breast Cancer Screening in Medium Clinics was 3.1% less than in Large Clinics while Cervical Cancer Screening and Colorectal Cancer Screening were 2.9% and 2.2% greater respectively. Small Clinics were also significantly different from Large Clinics for several of the variables. These clinics were 2.7% less for Breast Cancer Screening, but they were greater by 5.2% for Cervical Cancer Screening and 3.6% for Chlamydia Screening.

Off-base clinics were significantly less for Breast Cancer Screening (18.7%) than on-base clinics. OCONUS Clinics were all significantly different with Breast Cancer Screening (3.6%) and Colorectal Cancer Screening (3.0%) less than CONUS clinics and Cervical Cancer Screening (5.6%) and Chlamydia (4.7%) significantly greater. Primarily Active Duty Clinics were significantly greater for Cervical Cancer Screening (10.1%) and Chlamydia Screening (17.6%).

Our final analysis before conducting the differences-in-differences analysis was a multivariate linear analysis with the total sample but excluding the interaction term that defines differences-in-differences (Table 14). The Navy was significantly different from the Army for all but Cervical Cancer Screening with Breast Cancer Screening (1.4%) significantly greater but Chlamydia Screening (5.2%) and Colorectal Cancer Screening (3.7%) less than Army, adjusting for other factors. The Air Force was significantly less than the Army for all variables ranging from 3.7% for Colorectal Cancer Screening to 5.2% for Chlamydia Screening. Post-PCMH was significantly different from Pre-PCMH for all variables. Breast Cancer Screening (1.5%) and Colorectal Cancer Screening (3.4%) were significantly greater while Cervical Cancer Screening (2.9%) and Chlamydia Screening (4.6%) were significantly less.

Table 13: Multivariate Analysis of Preventive Care Measures by Air Force

	Breast Cancer			Cervical			Chlamydia			Colorectal		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Pre	Ref			Ref			Ref			Ref		
Post	3.0	1.3, 4.7	.001	-2.8	-3.6, -1.9	<.001	-4.2	-5.9, -2.5	<.001	2.1	.9, 3.3	<.001
Large	Ref			Ref			Ref			Ref		
Medium	-3.1	-6.0, -.2	.034	2.9	1.4, 4.5	<.001	.2	-2.7, 3.2	.870	2.2	.2, 4.2	.030
Small	-2.7	-5.2, -.1	.041	5.2	3.8, 6.6	<.001	3.6	1.0, 6..2	.007	.4	-1.4, 2.1	.678
On-base	Ref			Ref			Ref			Ref		
Off-base	-18.7	-34.8, -2.6	.023	2.2	-6.5, 11.0	.614	-8.4	-25.0, 8.1	.317	3.6	-7.4, 14.6	.521
CONUS	Ref			Ref			Ref			Ref		
OCONUS	-3.6	-5.7, -1.4	.002	5.6	4.5, 6.7	<.001	4.7	2.6, 6.8	<.001	-3.0	-4.6, -1.4	<.001
Not Primarily AD	Ref			Ref			Ref			Ref		
Primarily AD	5.4	-2.6, 13.5	.187	10.1	7.5, 12.7	<.001	17.6	12.5, 22.7	<.001	-2.2	-7.1, 2.7	.383

Table 14: Multivariate Analysis of All Variables for Preventive Care Measures

	Breast Cancer			Cervical			Chlamydia			Colorectal		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Army	Ref			Ref			Ref			Ref		
Navy	1.4	.3, 2.4	.011	.1	-.4, .7	.566	-3.2	-4.3, -2.1	<.001	-3.7	-4.6, -2.7	<.001
Air Force	-4.0	-5.3, -2.6	<.001	-4.8	-5.5, -4.1	<.001	-5.2	-6.7, -3.7	<.001	-3.7	-4.9, -2.5	<.001
Pre	Ref			Ref			Ref			Ref		
Post	1.5	.6, 2.4	.001	-2.9	-3.4, -2.5	<.001	-4.6	-5.6, -3.7	<.001	3.4	2.6, 4.1	<.001
Large	Ref			Ref			Ref			Ref		
Medium	-2.0	-3.2, -.8	.001	-1.3	-1.8, -.7	<.001	-2.6	-3.9, -1.4	<.001	-.7	-1.7, .4	.206
Small	-1.6	-3.0, -.2	.025	.5	-.1, 1.2	.121	1.2	-.3, 2.6	.122	-.3	-1.5, .9	.611
On-base	Ref			Ref			Ref			Ref		
Off-base	.2	-1.6, 2.0	.831	<.1	-1.0, 1.0	.970	-4.6	-6.7, -2.5	<.001	<.1	-1.5, 1.6	.962
CONUS	Ref			Ref			Ref			Ref		
OCONUS	-3.0	-4.1, -1.9	<.001	4.2	3.6, 4.7	<.001	5.1	4.0, 6.3	<.001	-.7	-1.7, .3	.172
Not Primarily AD	Ref			Ref			Ref			Ref		
Primarily AD	5.0	3.5, 6.6	<.001	9.1	8.5, 9.6	<.001	15.3	14.1, 16.5	<.001	.6	-.6, 1.9	.301

Diff – Absolute percent difference from the reference group

Medium Clinics were significantly less for Breast Cancer Screening (2.0%), Cervical Cancer Screening (1.3%), and Chlamydia Screening (2.6%) while Small Clinics were only significantly less for Breast Cancer Screening (1.6%) than Large Clinics. Off-base Clinics were only significant for Chlamydia Screening (-4.6%). OCONUS Clinics were significantly greater for Cervical Cancer Screening (4.2%) and Chlamydia Screening (5.1%) but significantly less for Breast Cancer Screening (3.0%). Primarily AD Clinics were significantly greater than those clinics that did not see primarily active duty patients for Breast Cancer Screening (5.0%), Cervical Cancer Screening (9.1%), and Chlamydia Screening (15.3%).

For the differences-in-differences analysis all the models were statistically significant at the .001 level (Table 15). The Air Force was significantly different from the Army across all dependent variables and had consistently negative results ranging from 2.1% (95% CI, .05-3.7%) less than the Army in completed Colorectal Cancer Screening to 5.8% (95% CI, 3.7-7.9%) less in completed Chlamydia Screening. The Navy, on the other hand, was not significantly different from the Army for Breast Cancer Screening or Cervical Cancer Screening, however it was significantly less for the remaining two variables—Chlamydia and Colorectal Cancer Screening (3.8% [95% CI, 2-5.5%] and 2.2% [95%CI, .07-3.6%]) respectively. While the pre-post assessment was not significant for Breast Cancer Screening, it was significantly less for Cervical Cancer (3.2%, [95% CI, 2.5-3.9%]) and Chlamydia (5.2%, [95% CI, 3.6-6.8%]) Screenings but increased for Colorectal Cancer Screening by 5% (95% CI, 3.7-6.2%).

Our differences-in-differences estimators indicate there was no statistically significant difference pre- and post-PCMH between the Navy and Army for Breast Cancer, Cervical Cancer and Chlamydia Screening. There was also no statistically significant difference between the Air Force and Army for Cervical and Chlamydia Screening over the time period.

Table 15: Differences-in-Differences Results for Preventive Care Measures

	Breast Cancer Screening			Cervical Cancer Screening			Chlamydia Screening			Colorectal Cancer Screening		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Army	Ref			Ref			Ref			Ref		
Navy	.4%	-1.2, 2.1	.599	-.1%	-.9, .7	.750	-3.8%	-5.5, -2.0	<.001	-2.2%	-3.6, -.7	.003
Air Force	-5.6	-7.5, -3.7	<.001	-5.0	-6.0, -4.0	<.001	-5.8	-7.9, -3.7	<.001	-2.1	-3.7, -.5	.012
Pre	Ref			Ref			Ref			Ref		
Post	.1	-1.3, 1.6	.852	-3.2	-3.9, -2.5	<.001	-5.2	-6.8, -3.6	<.001	5.0	3.7, 6.2	<.001
Navy Diff-in-Diff	1.6	-.5, 3.8	.138	.5	-.6, 1.5	.381	.9	-1.3, 3.1	.432	-2.5	-4.4, -.7	.007
Air Force Diff-in-Diff	2.8	.6, 5.0	.014	.4	-.8, 1.5	.533	.9	-1.5, 3.4	.453	-2.7	-4.6, -.8	.006
Large	Ref			Ref			Ref			Ref		
Medium	-2.0	-3.2, -.8	.001	-1.3	-1.8, -.7	<.001	-2.6	-3.9, 1.4	<.001	-.7	-1.7, .4	.194
Small	-1.6	-2.9, -.2	.025	.5	-.1, 1.2	.120	1.2	-.3, 2.6	.121	-.3	-1.5, .9	.598
On-base	Ref			Ref			Ref			Ref		
Off-base	.4	-1.5, 2.2	.696	<.1	-1.0, 1.0	.928	-4.6	-6.7, -2.5	<.001	-.1	-1.7, 1.4	.853
CONUS	Ref			Ref			Ref			Ref		
OCONUS	-3.0	-4.1, -1.9	<.001	4.2	3.6, 4.7	<.001	5.1	4.0, 6.3	<.001	-.7	-1.7, .3	.166
Not Primarily AD	Ref			Ref			Ref			Ref		
Primarily AD Patients	5.0	3.5, 6.6	<.001	9.1	8.5, 9.6	<.001	15.3	14.1, 16.5	<.001	.6	-.6, 1.8	.308
Adjusted R Squared	.161			.581			.397			.118		
F	26.1		<.001	226.6		<.001	104.0		<.001	18.3		<.001

Diff – Absolute percent difference from the reference group

The analysis suggests that the Air Force experienced significantly higher Breast Cancer Screening than the Army pre- and post-PCMH (2.8% [95% CI, .6-5%]). In contrast, the Army experienced improvements in Colorectal Cancer Screening over the study time period relative to both the Navy and Air Force (-2.5% [95% CI, -.7-(-4.4)%] and -2.7% [95% CI, -.8-(-4.6)%], respectively).

When it comes to preventive measures, apparently size matters in some instances. Medium facilities were significantly different from large facilities in all cases except colorectal cancer screening. Medium facilities had consistently lower percentages of screening than large facilities by 1.3 % (95% CI, .7-1.8%) to 2.6 % (95% CI, 1.4-3.9%). Small facilities, however, were lower than large facilities only in Breast Cancer Screening by 1.6% (95% CI, .2-2.9%); for all other dependent variables, they were not significantly different.

The location of the clinic, whether On-base or off, was only significant for Chlamydia Screening with the off-base clinics 4.6% (95% CI, 2.5-6.7%) lower than On-base clinics. However, OCONUS clinics were significantly different for all variables except Colorectal Cancer Screening, though in different directions. OCONUS was 3% (95% CI, 1.9-4.1%) lower than CONUS for Breast Cancer Screening but 4.2% (95% CI, 3.6-4.7%) higher for Cervical Cancer Screening and 5.1% (95% CI, 4-6.3%) higher for Chlamydia Screening. Similarly, primarily AD clinics were significantly different for all but Colorectal Cancer Screening, coming in higher for all variables—5% (95% CI, 3.5-6.6%) for Breast Cancer Screening, 9.1% (95% CI, 8.5-9.6%) for Cervical Cancer Screening and an amazing 15.3% (95% CI, 14.1-16.5%) for Chlamydia Screening.

DISCUSSION

The results of our analysis are mixed with both increasing and decreasing screening percentages across the service branches pre- and post-PCMH. Further, the differences-in-differences analysis suggests that the Army significantly improved Colorectal Cancer Screening over time relative to both the Navy and Air Force. Conversely, the Navy and Air Force increased

Breast Cancer Screening relative to the Army, although the differences-in-differences estimate for the Navy was not statistically significant. However, while many of these differences may be statistically significant, their absolute magnitudes were generally small and thus they are of uncertain clinical significance. Rosenthal et al. (2015) found similar mixed results though in a different direction. In their study, they found improved cervical and breast cancer screening but decreased colon cancer screening (Rosenthal et al., 2015).

Although it is difficult to explain our results, there are many factors that could not be taken into consideration. For example, the composition of the population (e.g., age and gender) was likely to be different between the Army, Navy, and Air Force. Also, the mobility of the patient population and provider turnover may have been important factors that produced inconsistent patterns of quality.

What does this mean for policy-makers and those seeking to implement the PCMH model in their organizations? In essence, the decision to implement a PCMH model does not mean that quality will automatically improve for preventive screening indicators. As a result, it is more important to focus on the effectiveness of specific processes and procedures (e.g., care management follow up, regular analysis of EHR data, and leadership and experience of the staff) and consistently measure the results. Changing the culture of the organization is usually very challenging and often takes considerable time. For those seeking to implement the PCMH model in their organization, PCT composition should be structured in the way that best fits their clinic without being concerned that there is an ideal one size fits all option.

For the MHS, these findings seem to indicate that it may be desirable to develop and compare various metrics across the clinics in the MHS. These metrics could include cost, manning, and readiness--being prepared for the wartime mission—as well as quality. The Pre-Post comparison outcomes may provide some preventive outcome measures that could be used to compare and ultimately improve quality of care. For those clinics that are unable to meet the targets, it would be advantageous to provide technical assistance so that all clinics could eventually meet the standards.

Limitations of the Study

The limitations of the study should be considered when interpreting the results. For example, not all factors can be considered in any research design. It is possible that other quality improvement initiatives beyond PCMH had an impact on the results, especially at the clinic level where, even though implementing PCMH, local leaders may have been implementing other process improvements. Though PCMH was not implemented in most clinics until 2010/2011, there was some movement towards the implementation of the PCMH model before the official start date. This movement may have accelerated the increases in the quality preventive measures so that PCMH did not have a large effect on the measures after implementation.

While the MHS, in many ways, mirrors the civilian healthcare system, there are enough differences that the findings may not be generalizable to all medical practices. For instance, while the MHS may have had more robust resources to apply to PCMH implementation as compared to non-government pilots, one of its unique differences is that salaried, military PCMH teams have few incentives to buy-in to process improvement because it will not change their compensation nor likely decrease their work load. The mobility of both the health work force and the patient population as well as the executive leadership is another challenge that could not be accounted for in this study.

The parent-child relationship of many of the PCMH clinics to the same MTFs may cause some clustering effects which are not accounted for in the linear model we utilized. Our data did not provide sufficient information to completely describe the characteristics of the MTFs. Our linear model may provide similar estimation results as a mixed effects hierarchical model.

Another limitation in finding statistically significant differences could lie with the already high HEDIS scores. These metrics were already a focus in the MHS and so may have created a 'ceiling effect' in our pre-PCMH data. Another possibility is that there is something unique to military culture or military health care that contributes to these already high metrics. It is possible that the patients are more highly engaged or it could be due to not having to pay for screenings. In any case, the PCMH implementation may have had little room for improvement in the already excellent approach to ensure patients were screened for these measures.

CONCLUSION

Increasing the level of preventive care is only one part of the changes in care delivery attributed to PCMH. In fact, PCMH began as a program to help those with chronic conditions (Sia, Tonniges, Osterhus, & Taba, 2004) and so additional research should be done to determine if PCMH implementation has led to a higher impact on chronic care quality outcomes. The impact of other proposed benefits of the PCMH model such as lower provider burn-out, reduced medical staff turnover and decreased costs should also be investigated.

It is also possible that analyzing data from more recent years may show more consistent results between the branches of the MHS. It often takes time to change the culture of an organization, including the “champions” to lead this change. In addition, building the care management capacity and understanding how to analyze and use EHR data often requires considerable experience. With frequent staff and patient turnover, this may be an even more significant factor in the MHS.

The mixed results of this study are not dissimilar to past research on the overall results of PCMH. Many of the evaluations of quality and cost reduction have also shown mixed results with some studies indicating positive outcomes and others showing no difference (Arend, Tsang-Quinn, Levine and Thomas, 2012; Maeng et al., 2015; Reid et al., 2013; Stewart et al., 2010). Continued research into other possible impacts of PCT composition should be realized before any final determinations are made.

CHAPTER 4: EXAMINING THE EFFECT OF PATIENT-CENTERED MEDICAL HOME ON CHRONIC CARE MEASURES IN THE MILITARY HEALTH SYSTEM

INTRODUCTION

The high cost of medical care for treating chronic diseases is a major driver of healthcare costs in the U.S. because 60% of adults suffer from at least one chronic disease (CDC, 2018a). Of these chronic illnesses, heart disease is the leading cause of death while diabetes affects more than 29 million Americans (CDC, 2018b). Incidence rates of diabetes amongst active duty members mirrors that of the general population, even though they tend to be young and active (Paris, Bedno, Krauss, Keep & Rubertone, 2001). While diabetes or heart disease precludes acceptance to military service, development of these conditions does not lead to an automatic discharge, though failure to maintain low Hemoglobin A1C (HbA1C) levels without medication may (Hieronymus & Rickerson, 2015). Though prevalence of diabetes may be lower amongst active duty members than the general population, both heart disease and diabetes are just as common amongst the dependent and retiree beneficiaries (Andrews, 2013).

The PCMH model was first developed as a program to help those with chronic conditions (Sia, Tonniges, Osterhus, & Taba, 2004). Since its adoption by the primary care community the results of PCMH on chronic care improvement have been mixed. Friedberg et al. (2014) found only one significant association out of seven chronic care measures while Phillips, Han, Petterson, Makaroff & Liaw (2014) found significant quality improvements in all six chronic measures studied. Saucier et al. (2017), in a study focused specifically on diabetes care, identified increasing trends in important diabetes care metrics as part of a PCMH.

Studies of the impact of PCMH on chronic quality measures in the MHS have also been mixed. Savage, Lauby & Burkard (2013) found a statistically significant increase in three of four measures at one Naval MTF and, while Christensen et al., (2013) found post-implementation improvement in multiple HEDIS metrics at Walter Reed Military Medical Center, at the time an

Army facility, but they were not significantly different from the comparison groups. Andrews (2013), in a study of 13 Air Force clinics, found significant differences in three of the clinics post PCMH implementation. There are no MHS wide studies of PCMH.

While these research results indicate that the PCMH model is impacting the more than 9 million beneficiaries in the MHS, little is known about how the differences in PCMH approach have affected chronic care outcomes across the MHS (Hudak et al., 2013; Uniformed Services Academy of Family Physicians, 2014). In this study we seek to examine how different approaches to PCMH implementation by the Army, Navy and Air Force can impact the quality of care. We hypothesized that the independent development of PCMH models and team composition by the Army, Navy, and Air Force might lead to important differences in chronic care quality measures of PCMH success.

METHODS

Data and Sample

We used a pooled cross-sectional research design with secondary data to assess the impact of PCMH on six clinical quality measures. Measures were taken from those suggested by Rosenthal, Abrams, Bitton and The Patient-Centered Medical Home Evaluators' Collaborative in their 2012 data brief titled "Recommended Core Measures for Evaluating the Patient-Centered Medical Home: Cost, Utilization and Clinical Quality" and which have been utilized in multiple PCMH studies (Baker & Laughlin, 2017; Dobbins, et al., 2018; McManus, 2017). These include measures for both heart disease and diabetes management. The data for these measures was extracted from M2 and aggregated at the clinic level with the PCMH clinic as the unit of interest.

The sample was based on data drawn from all the PCMH practicing clinics in the MHS for each calendar year from 2010 to 2014. There are 158 MTFs spread across all three services with more than 300 PCMH practicing clinics. Of these, the Air Force operates 72 MTFs with 72 clinics, 36 MTFs with 139 clinics are run by the Army and the Navy manages 28 MTFs with 103 clinics. Clinics share a parent-child relationship with the MTF. For the Air Force there is only one PCMH clinic at each MTF, however, the Army and Navy, with larger bases and increased number of personnel, often have multiple PCMH clinics at their MTFs. In some instances, these clinics are co-located but they can also be in separate buildings or even Off-base within the local community.

The quality measures were drawn from a patient-level utilization database managed by the MHS known as M2. In this study, there were 1,745 total records for each of the primary measures. All clinics with 20 or less eligible beneficiaries were removed because the dependent variable is a percentage and the smaller clinics would be more likely to introduce bias in the final results. The final numbers ranged from 709 for Cholesterol Screening to 1,170 for HbA1C Poor Control. The variability in these numbers is most likely due to the population served by most MTFs. The MTFs exist to first serve the active duty military members to keep them healthy and ready to fulfill the mission of their branch of service. However, they also serve the family members of the active duty military members. Together this population tends to be young (under 45) and healthier. The third group of beneficiaries seen at MTFs are retirees who have the option of receiving their care at a military clinic but may choose to be seen at a clinic closer to home. For this and other reasons, such as the location of the MTF, the retiree population at most MTFs is small. Unsurprisingly, more than 95% of those that had a heart condition and were screened for Cholesterol were 45 or older while 85% of those with diabetes were 45 or older.

The data were analyzed using SPSS Version 24 and significance levels were assumed at p values less than .05.

Measures

Our dependent variables for heart disease are Cholesterol Screening and, for diabetes management, they are Retinal Exam, HbA1C Screening and Control, and LDL-C Screening and Control (Table 16). All of these variables are identical to the NCQA HEDIS metrics. The primary independent variables were the branch of service, whether Army, Navy or Air Force with

Army as the control variable, a pre-post comparison and the interaction between branch of service and the pre-post assessment. Other independent variables included whether the clinic is located On-base or off, whether the clinic is CONUS or OCONUS, whether the clinic saw primarily AD patients (≥90%) and, finally, the size of the parent facility.

Outcomes were assessed for each clinic on December 31 of each calendar year included in the study. Outcomes were measured for each of the six tests by the proportion of patients assigned to the clinic who were up-to-date on each of the tests. The denominator of this proportion consists of patients who fit the risk profile for whom screening is recommended by the relevant practice guideline. The numerator consists of patients who had the appropriate test done within the time frame defined by the guideline. Because the military uses a common, shared EHR across all practice sites, whether a patient is up-to-date at a given clinic location can be determined accurately even if the screening occurred in a different military facility.

The HEDIS measures used as our dependent variables were unchanged from 2010-2014, however, for HEDIS 2015 Cholesterol Management for Patients with Cardiovascular Conditions and LDL-C Screening and Control as part of Comprehensive Diabetes Management were removed (Managed Healthcare Executive, 2014). This was done to better align with current evidence and changing cholesterol guidelines as published by the American College of Cardiology/American Heart Association Task Force (Managed Healthcare Executive, 2014). These changes should have no impact on our period of study. Measures were calculated by dividing the total number of those screened by the total number eligible for the screening.

Facilities range in size from several hundred employees to several thousand with corresponding budgets and number of beneficiaries. Since the data is considered by the MHS to be FOUO the actual numbers could not be used in this study. As a result, each MTF was assigned to one of three size categories—small, medium or large--as determined by the number of FTE employees. The large category included all MTFs with 1,000 or more FTEs, the medium category of MTFs between 370 and 999 FTEs, while the small category included all MTFs with less than 370 FTEs.

While the majority of MHS PCMH clinics are primarily manned by active duty personnel, including providers, nurses, medical technicians and administrative personnel, there are several MHS clinics that are primarily manned by civilian personnel. These personnel are either GS or contracted. The civilian manned clinics tend to be located off-base. To capture the effect of these clinics on quality measures we created a binary variable on whether the clinics were manned primarily by civilian personnel.

Statistical Analysis

To evaluate the impact of PCMH implementation on chronic care quality outcomes in the various branches of military service we used univariate, bivariate and linear multivariate regression analysis as well as a differences-in-differences analysis, a quasi-experimental study design that is frequently used to determine associations after policy changes (Rajaram et al, 2014). Differences-in-differences models were created to compare chronic care quality outcomes in PCMH clinics by branch of service before and after PCMH implementation. The dependent variable in each model was the quality measure and the primary independent variables were the branch of service, a pre-post assessment and the interaction between the branch of service and the pre-post assessment (Table 16). Other independent variables were included as detailed above.

Table 16: Independent and Dependent Variables for Chronic Care Measures

Name	Description		Type
Cholesterol Screening	Percentage of patients with cardiovascular conditions screened for cholesterol	Continuous	Primary Dependent
Retinal Exam	Percentage of patients ages 18-75 with diabetes diagnosis (type 1 and 2) who had a retinal eye exam	Continuous	Primary Dependent
HbA1C Testing	Percentage of patients ages 18-75 with diabetes diagnosis (type 1 and 2) who had HbA1C testing	Continuous	Primary Dependent

HbA1C Poor Control	Percentage of members ages 18-75 with diabetes diagnosis (type 1 and type 2) who had poor Hba1c control (>9.0%)	Continuous	Primary Dependent
LDL-C Screening	Percentage of members ages 18-75 with diabetes diagnosis (type 1 and type 2) who had an LDL-C screening	Continuous	Primary Dependent
LDL-C Good Control	Percentage of members ages 18-75 with diabetes diagnosis (type 1 and type 2) who had good LDL-C control (<100 mg/dL)	Continuous	Primary Dependent
Branch of Service	Army, Navy, Air Force	Categorical	Primary Independent
Pre-Post Assessment	Pre: 2010-11, Post-2012-2014	Categorical	Primary Independent
Differences-in-Differences Estimator (interaction)	Interaction between branch of service and Pre-Post Assessment	Categorical	Primary Independent
CONUS vs. OCONUS	Contiguous United States vs. Overseas	Categorical	Secondary Independent
On-base vs. Off	Clinic located On-base or Off-base	Categorical	Secondary Independent
Size	By FTE; Large>999; Medium=370-999; Small<370	Categorical	Secondary Independent
Primarily AD Patients	Not Primarily Active Duty (<90% AD patients); Primarily Active Duty (≥90% AD patients)	Categorical	Secondary Independent

For our differences-in-differences analysis the Army was the control group compared to the Navy and Air Force to analyze the effect of the intervention. Since all the branches of service incorporated PCMH at roughly the same time, our intervention was the implementation of the PCMH model with differences-in-differences adjusting for other unmeasured variables that would affect all branches of service similarly. The basic differences-in-differences equation includes two dummy variables, one for the control and treatment groups and the other for the pre-post assessment. It also includes an interaction term between the two dummy variables with the equation appearing as:

$$Y=b_0+b_1x_1+b_2x_2+b_3x_1x_2$$

Because we have three groups we gain an additional dummy variable as well as an additional interaction term modifying our base equation to:

$$Y=b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_1x_3+b_5x_2x_3$$

Where x_1 will be Navy, x_2 is Air Force and x_3 is our time variable. The interaction terms are our differences-in-differences estimators with the coefficients indicating the extent of association between the branch of service and the dependent variable.

RESULTS

Descriptive statistics were calculated for the clinics by branch of service (Table 17) as well as for the dependent variables (Table 18). Data points ranged from 1,967 for the Navy to 2,548 for the Army. The Army had slightly more of the Pre-PCMH outcomes (38.3%) and gained slightly more for the Post-PCMH (39.3%) while the Navy and Air Force had slightly less than one-third each for both Pre and Post (30.8%/29.5% and 30.9%/31.3% respectively).

Table 17: Descriptive Statistics of Clinics for Chronic Care Measures

Characteristic	Army	Navy	Air Force
N	2548	1967	2040
Pre	38.3%	30.8%	30.9%
Post	39.3	29.5	31.3
Large	55.5	36.4	8.1
Medium	19.4	25.7	54.8
Small	6.6	5.6	87.7
On-base	36.6	29.6	33.6
Off-base	66.9	31.9	1.2
CONUS	37.8	31.3	30.9
OCONUS	45.2	22.6	32.2
Not Primarily AD	37.4	29.0	33.6
Primarily AD	57.1	42..9	0.0

The Air Force had the largest percentage of small and medium clinic outcomes (87.7% and 54.8%) and the fewest number of large clinic outcomes (8.1%) while the Army and Navy were roughly equal in small clinic outcomes (6.6% and 5.6%). More than half of the large clinic outcomes came from the Army (55.5%). Outcomes were nearly evenly distributed for on-base clinics across the branches of service (Army 36.6%, Navy 29.6%, Air Force 33.6%), however the

Air Force had almost no outcomes from off-base clinics (1.2%) while the Army had more than two-thirds (66.9%). CONUS outcomes were also close to evenly distributed (Army 37.8%, Navy 31.3%, Air Force 30.9%) while the Army had nearly half of the OCONUS outcomes (45.2%). Not Primarily AD clinic outcomes were around one-third each (Army 37.4%, Navy 29.0%, Air Force 33.6%) however, the Air Force had no Primarily AD clinic outcomes with the remainder coming 57.1% from the Army and 42.9% from the Navy.

Table 18: Descriptive Statistics of Chronic Care Dependent Variables

	Heart Disease	**Diabetes**				
	Cholesterol Screening	**Retinal Exam**	**HbA1C Screening**	**HbA1C Poor Control**	**LDL-C Screening**	**LDL-C Good Control**
N	709	1169	1169	1170	1169	1169
Mean	81.5%	73.4%	88.1%	25.3%	84.6%	49.2%
Standard Deviation	8.8	8.7	6.62	8.5	7.2	10.1
Median	82	73.62	89.2	23.8	85.6	50.6
Army	34	40	40	40	40	40
Navy	27	30	30	30	30	30
Air Force	39	30	30	30	30	30
Large	51	55	55	55	55	55
Medium	22	22	22	22	22	22
Small	27	23	23	23	23	23
On-base	94	92	92	92	92	92
Off-base	6	8	8	8	8	8
CONUS	97	84	84	84	84	84
OCONUS	3	16	16	16	16	16
Not Primarily AD	99	92	92	92	92	92
Primarily AD	<1	8	8	8	8	8

There were 709 data points for Cholesterol Screening and 1,169 data points for most of the diabetes measures with slightly more Air Force in the cholesterol screening and more Army in the diabetes measures (Table 18). More than half of all clinics belonged to a large MTF and 92-94% were on-base clinics. While 97% of the cholesterol screenings took place in CONUS clinics

16% of diabetes care was occurring in OCONUS clinics. Less than 1% of cholesterol screenings and 8% of diabetes care are active duty patients. Average screening rates ranged from 49.16% (SD: 10.12%) for good control of LDL-C to 88.05% (SD: 6.62%) for HbA1C screening. Poor control of HbA1C is a negative indicator, signifying that approximately one fourth (SD: 8.47%) of those who are being treated for diabetes in MTFs are not properly controlling their HbA1C levels.

We conducted sensitivity analysis over several steps beginning with a bivariate linear regression analysis by branch of service (Table 19). At this level we found mixed results for significant differences between the Army and either the Navy or Air Force. Cholesterol Screening was significantly different from the Army for both the Navy and Air Force though in different directions with the Navy having 3.3% higher Cholesterol Screening percentages than the Army and the Air Force had 3.5% less. The Air Force was significantly greater than the Army by 2.4% in Retinal Exams and significantly less by 1.8% for HbA1C Screening. Both the Navy and Air Force were significantly greater than the Army for diabetics with LDL-C Good Control (differences of 4.8% and 6.8%, respectively).

Table 19: Bivariate Analysis of Chronic Care Measures by Branch of Service

Measure	Army			Navy			Air Force		
	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig
Cholesterol Screening	81.8	80.4, 82.9	<.001	85.1	83.5, 86.7	<.001	78.3	77.2, 80.1	<.001
Retinal Exam	73.0	72.2, 73.8	<.001	71.8	70.6, 73.0	.055	75.4	74.2, 76.6	<.001
HbA1C Screening	87.7	87.0, 88.3	<.001	88.3	87.4, 89.3	.176	88.4	87.4, 89.3	.158
HbA1C Poor Control	26.0	25.2, 26.8	<.001	25.4	24.2, 26.5	.278	24.2	23.0, 25.4	.002
LDL-C Screening	84.2	83.6, 84.9	<.001	85.1	84.1, 86.1	.070	84.5	83.5, 85.5	.585
LDL-C Good Control	45.7	44.8, 46.8	<.001	50.5	49.1, 51.8	<.001	52.5	51.2, 53.9	<.001

We continued with a bivariate linear analysis of each of the dependent variables by the Pre- and Post-PCMH variable with time variables defined as Pre-PCMH (2010-11) and Post-

PCMH (2012-14). Post-PCMH was significantly different from Pre-PCMH for all measures except LDL-Good Control (Table 20). We found that Post-PCMH Cholesterol Screening (4.0% difference), HbA1C Screening (2.9%) and LDL-C Screening (2.3%) were significantly higher than the Pre-PCMH period while Retinal Exams (2.6%) and HbA1C Poor Control (2.4%) were significantly less.

Table 20: Bivariate Analysis of Chronic Care Measures by Pre-Post PCMH

		Pre			Post	
Measure	Mean	95% CI	Sig	Mean	95% CI	Sig
Cholesterol Screening	79.1%	78.2, 80.1	<.001	83.1%	81.8, 84.3	<.001
Retinal Exam	74.9	74.1, 75.7	<.001	72.3	71.3, 73.4	<.001
HbA1C Screening	86.3	85.7, 86.9	<.001	89.2	88.4, 90.0	<.001
HbA1C Poor Control	26.5	25.7, 27.2	<.001	24.1	23.5, 25.4	<.001
LDL-C Screening	83.2	82.6, 83.8	<.001	85.5	84.7, 86.4	<.001
LDL-C Good Control	49.1	48.1, 50.0	<.001	49.3	48.1, 50.5	.762

Next, we performed a multivariate analysis for each of the dependent variables stratified by the branch of service (Tables 21-23). The tables show the coefficient as a percent (%) difference relative to a comparison group. For the Army (Table 21), the model for Cholesterol Screening was not significant. Post-PCMH was significantly different for all other measures. It was significantly less for Retinal Exam (2.3%), HbA1C Poor Control (1.9%), and LDL-C Good Control (2.1%) but significantly higher for HbA1C Screening (2.5%) and LDL-C Screening (1.6%). Size was only significant for Retinal Exam where Small was significantly less (3.8%) than Large.

Off-base was significantly different from On-base for both HbA1C Poor Control and LDL-C Good Control though in opposite directions—significantly higher for the first by 3.8%

and lower for the second by 4.6%. OCONUS was significantly different from CONUS for all but HbA1C Poor Control, though only Retinal Exam (3.5%) was higher. HbA1C Screening (3.7%), LDL-C Screening (2.3%), and LDL-C Good Control (7.7%) were all lower. Primarily Active Duty clinics were significantly different for all but HbA1C Screening. LDL-C Good Control was the only measure significantly lower (7.1%) with Retinal Exam (8.8%), HbA1C Poor Control (2.4%) and LDL-C Screening (2.0%) all significantly higher than those clinics that do not see primarily active duty patients.

For the Navy, Post-PCMH differed significantly for all measures but LDL-C Good Control (Table 22). Cholesterol Screening (5.8%), HbA1C Screening (2.8%), and LDL-C Screening were all higher than Pre-PCMH with HbA1C Poor Control (2.2%) and Retinal Exams (2.3%) lower. Size had little impact as only Medium MTFs for Retinal Exam (8.0% lower) and HbA1C Poor Control (2.7% higher) had significant differences from Large MTFs.

Off-base clinics were significantly better than On-base clinics in their chronic care measures except Cholesterol Screening and Retinal Exams. HbA1C Screening (2.6%), LDL-C Screening (3.6%), and LDL-C Good Control were all significantly higher with HbA1C Poor Control (7.0%) lower. OCONUS bases were significantly different for Retinal Exam (11.8% higher) and LDL-C Good Control (.3% lower) while the Primarily AD clinics were significantly higher for Retinal Exam (4.2%) and HbA1C Poor Control (8.0%) but lower for HbA1C Screening (8.7%), LDL-C Screening (5.2%), and LDL-C Good Control (9.4%).

Post-PCMH differed significantly from Pre-PCMH in the Air Force for all but LDL-C Good Control (Table 23). For Cholesterol Screening (6.4%), HbA1C Screening (2.8%), and LDL-C Screening (2.4%) Post-PCMH was higher than Pre-PCMH and lower for Retinal Exam (2.1%) and HbA1C Poor Control (2.4%). Medium facilities were significantly higher than Large for Cholesterol Screening (5.0%), HbA1C Screening (3.5%), and LDL-C Screening and lower for HbA1C Poor Control (2.2%). The only significant difference between Small and Large facilities in the Air Force was for Cholesterol Screening, which was higher by 3.3%.

Table 21: Multivariate Linear Regression Analysis of Chronic Care Measures by Army

	Cholesterol Screening			Retinal Exam			HbA1C Screening			HbA1C Poor Control*			LDL-C Screening			LDL-C Good Control		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Pre	Ref			Ref			Ref			Ref			Ref			Ref		
Post	.5	-1.2, 2.2	.587	-2.3	-3.7, -.9	.002	2.5	1.3, 3.7	<.001	-1.9	-3.4, -.3	.017	1.6	.2, 2.9	.021	-2.1	-3.8, -.3	.020
Large	Ref			Ref			Ref			Ref			Ref			Ref		
Medium	-2.6	-4.8, -.4	.021	-.9	-2.8, 1.1	.388	-.4	-2.1, 1.2	.618	.5	-1.6, 2.7	.625	-.4	-2.3, 1.4	.631	-1.0	-3.4, 1.5	.432
Small	-1.1	-5.1, 2.8	.292	-3.8	-6.5, -1.1	.006	-.6	-2.9, 1.7	.599	1.1	-1.7, 4.0	.433	-.3	-2.8, 2.2	.825	.9	-2.4, 4.3	.577
On-base	Ref			Ref			Ref			Ref			Ref			Ref		
Off-base	-1.8	-5.0, 1.5	.292	.4	-1.8, 2.5	.738	-1.2	-3.0, .6	.193	3.8	1.5, 6.0	.001	-.8	-2.7, 1.2	.432	-4.6	-7.2, -2.0	.001
CONUS	Ref			Ref			Ref			Ref			Ref			Ref		
OCONUS	2.3	-3.1, 7.8	.393	3.5	1.6, 5.3	<.001	-3.7	-5.2, -2.1	<.001	1.1	-.8, .31	.250	-2.3	-4.0, .6	.009	-7.7	-10.0, -5.5	<.001
Not Primarily AD	Ref			Ref			Ref			Ref			Ref			Ref		
Primarily AD	14.1	1.2, 27.0	.032	8.8	6.7, 11.0	<.001	-.7	-2.5, 1.1	.461	2.4	.1, 4.7	.043	2.0	<.1, 4.0	.048	-7.1	-9.7, -4.4	<.001

Diff – Absolute percent difference from the reference group
*HbA1C Poor Control is a negative indicator—lower is better

Table 22: Multivariate Linear Regression Analysis of Chronic Care Measures by Navy

	Cholesterol Screening			Retinal Exam			HbA1C Screening			HbA1C Poor Control			LDL-C Screening			LDL-C Good Control		
	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig
Pre	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Post	5.8	3.1, 8.4	<.001	-2.3	-4.3, -.3	.025	2.8	1.5, 4.2	<.001	-2.2	-4.1, -.4	.020	2.8	1.3, 4.3	<.001	1.8	-.3, 3.9	.085
Large	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Medium	-2.2	-5.4, .9	.165	-8.0	-10.4, -5.5	<.001	-.1	-1.7, 1.5	.907	2.7	.4, 4.9	.020	.2	-1.6, 2.0	.820	.8	-1.7, 3.3	.544
Small	.5	-4.6, 5.5	.856	<.1	-3.8, 3.8	.999	1.3	-1.2, 3.9	..307	-.4	-3.9, 3.1	.815	2.2	-.6, 5.0	.130	.1	-3.8, 4.0	.960
On-base	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Off-base	.8	-3.4, 5.0	.712	.3	-3.6, 4.1	.898	2.6	<.1, 5.2	.050	-7.0	-10.6, -3.4	<.001	3.6	.7, 6.5	.014	7.3	3.3, 11.2	<.001
CONUS	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
OCONUS	2.6	-8.3, 13.5	.640	11.8	8.6, 15.0	<.001	-1.8	-4.0, .3	.097	-2.4	-5.4, .6	.116	-2.0	-4.4, .4	.108	-.34	-6.7, -.1	.046
Not Primarily AD	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Primarily AD	10.8	-2.1, 23.7	.101	4.2	1.0, 7.4	.011	-8.7	-10.8, -6.5	<.001	8.0	5.1, 11.0	<.001	-5.2	-7.6, -2.8	<.001	-9.4	-12.8, -6.1	<.001

Diff – Absolute percent difference from the reference group
*HbA1C Poor Control is a negative indicator—lower is better

Table 23: Multivariate Linear Regression Analysis of Chronic Care Measures by Air Force

	Cholesterol Screening			Retinal Exam			HbA1C Screening			HbA1C Poor Control			LDL-C Screening			LDL-C Good Control		
	Diff	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**	**Diff**	**95% CI**	**Sig**
Pre	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Post	6.4	4.4, 8.4	<.001	-2.1	-3.4, -.7	.003	2.8	1.6, 4.1	<.001	-2.4	-4.0, -.7	.004	2.4	.9, 3.9	.002	.6	-1.2, 2.3	.514
Large	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Medium	5.0	1.9, 8.2	.002	<.1	-2.2, 2.3	.973	3.5	1.4, 5.6	.001	-2.2	-4.9, .5	.115	4.2	1.6, 6.7	.001	-1.2	-4.1, 1.8	.431
Small	3.3	.5, 6.0	.021	-.9	-2.9, 1.2	.395	1.9	-<.1, 3.7	.053	.7	-1.7, 3.1	.584	2.2	-<.1, 4.5	.052	-2.5	-5.1, .1	.057
On-base	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Off-base	1.0	-15.4, 17.5	.901	-7.0	-19.7, 5.7	.277	6.1	-5.7, 17.8	.308	-2.9	-17.8, 12.1	.708	7.8	-6.2, 21.9	.275	-1.8	-18.1, 14.6	.833
CONUS	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
OCONUS	-.4	-6.1, 5.3	.892	6.1	4.2, 8.0	<.001	-1.2	-3.0, .6	.178	-1.2	-3.4, 1.0	.295	-1.9	-4.0, .2	.074	-4.2	-6.6, -1.7	.001
Not Primarily AD	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-	Ref	-	-
Primarily AD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Diff – Absolute percent difference from the reference group
*HbA1C Poor Control is a negative indicator—lower is better

There were no significant results between Off- and On-base clinics. Retinal Exam was 6.1% higher at Air Force OCONUS clinics as compared to CONUS while LDL-C Good Control was 4.2% lower. There are no data points for chronic care conditions at Air Force clinics where they see primarily AD patients.

Our final analysis before conducting the differences-in-differences analysis was a multivariate linear analysis with the total sample but excluding the interaction term that defines differences-in-differences (Table 24). Including all variables but the interaction terms we found that the Navy and Air Force were both significantly higher than the Army in LDL-C Good Control by 4.3% and 6.1% respectively and for Cholesterol Screening the Navy is 3.3% higher than the Army but the Air Force is 3.3% lower. While the Navy had no other significant differences from the Army, the Air Force was significantly higher in Retinal Exam (5.0%) and lower in HbA1C Poor Control (2.1%). Post-PCMH was significantly different then Pre-PCMH for all measures but LDL-C Good Control. Post-PCMH was higher than Pre-PCMH for Cholesterol Screening (4.1%), HbA1C Screening (2.7%), and LDL-C Screening (2.2%) and lower for Retinal Exam (2.2%) and HbA1C Poor Control (2.1%).

Medium facilities only differed significantly from Large in Retinal Exam (3.1% lower) as did Small facilities (2.5% lower). Small facilities also differed from Large in HbA1C Poor Control (1.6% higher). Off-base clinics did not differ significantly from On-base clinics for any of the measures. OCONUS differed significantly from CONUS clinics in several measures. They were higher for Retinal Exam (6.2%) but lower for HbA1C Screening (2.2%), LDL-C Screening (1.8%), and LDL-C Good Control (5.3%). Primarily AD clinics were significantly different from their reference measure for all but LDL-C Screening with Cholesterol Screening (12.9%), Retinal Exam (6.6%), and HbA1C Poor Control (4.8%) were higher and HbA1C Screening (4.1%) and LDL-C Good Control (8.3%) were lower.

Table 24: Multivariate Linear Regression Analysis of Chronic Care Variables

	Cholesterol Screening			Retinal Exam			HbA1C Screening			HbA1C Poor Control			LDL-C Screening			LDL-C Good Control		
	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig
Army	Ref			Ref			Ref			Ref			Ref			Ref		
Navy	3.3	1.7, 4.9	<.001	-.4	-1.5, .7	.474	.5	-.4, 1.4	.312	-.8	-1.9, .4	.199	.8	-.2, 1.8	.124	4.3	3.0, 5.6	<.001
Air Force	-3.3	-5.0, -1.5	<.001	5.0	3.6, 6.4	<.001	-<.1	-1.2, 1.1	.939	-2.1	-3.6, -.7	.004	-.2	-1.5, 1.0	.718	6.1	4.5, 7.7	<.001
Pre	Ref			Ref			Ref			Ref			Ref			Ref		
Post	4.1	2.9, 5.3	<.001	-2.2	-3.2, -1.3	<.001	2.7	2.0, 3.5	<.001	-2.1	-3.1, -1.1	<.001	2.2	1.4, 3.0	<.001	-.1	-1.2, 1.0	.813
Large	Ref			Ref			Ref			Ref			Ref			Ref		
Medium	-.4	-2.0, 1.2	.654	-3.1	-4.4, -1.8	<.001	.8	-.2, 1.8	.116	.5	-.8, 1.8	.442	1.0	-.1, 2.1	.085	<.1	-1.4, 1.5	.948
Small	.3	-1.6, 2.2	.770	-2.5	-4.0, -1.1	.001	.3	-.9, 1.4	.661	1.6	.1, 3.1	.043	.7	-.6, 2.0	.315	-.9	-2.6, .8	.276
On-base	Ref			Ref			Ref			Ref			Ref			Ref		
Off-base	-.3	-2.9, 2.4	.844	.4	-1.4, 2.2	.653	.3	-1.1, 1.8	.659	.2	-1.7, 2.1	.855	.8	-.8, 2.4	.335	-1.0	-3.1, 1.1	.360
CONUS	Ref			Ref			Ref			Ref			Ref			Ref		
OCONUS	.7	-3.2, 4.6	.742	6.2	4.9, 7.5	<.001	-2.2	-3.2, -1.1	<.001	-.7	-2.1, .6	.292	-1.8	-2.9, -.6	.003	-5.3	-6.8, -3.7	<.001
Not Primarily AD	Ref			Ref			Ref			Ref			Ref			Ref		
Primarily AD	12.9	3.7, 22.2	.006	6.6	4.9, 8.3	<.001	-4.1	-5.5, -2.8	<.001	4.8	3.0, 6.6	<.001	-1.1	-2.6, .5	.166	-8.3	-10.3, -6.3	<.001

Diff – Absolute percent difference from the reference group
*HbA1C Poor Control is a negative indicator—lower is better

For the differences-in-differences analysis all the models were statistically significant at the .001 level (Table 25). The Navy was not significantly different from the Army for any of the dependent variables. The Air Force was significantly less than the Army in Cholesterol Screening by 6.9% but significantly higher in both Retinal Exams (5.1%) and LDL-C Good Control (4.53%) and not significantly different for the other three dependent variables.

While the pre-post assessment was not significant for Cholesterol Screening, it was significantly less for Retinal Exam (2.01%), HbA1C Poor Control (1.71%,) and LDL-C Good control (2.25%) but increased for HbA1C Screening by 2.55% and LDL-C Screening by 1.53%.

Our differences-in-differences estimators indicate there was no significant difference pre- and post-PCMH for Retinal Exam, HbA1C Screening, HbA1C Poor Control and LDL-C Screening for the Navy or Air Force relative to the Army. Both Navy and Air Force improved Cholesterol Screening (5.5% and 6.1%) over the time period relative to the Army. Results for LDL-C Good Control were similar (4.1% and 2.8% for Navy and Air Force, respectively).

For these chronic care measures, size matters only in a few instances. Medium facilities were significantly different from Large facilities for Retinal Exams where they came in 3.11% lower. Small facilities were also lower than Large facilities for Retinal Exams by 2.51% but increase by 1.57% for HbA1C Poor Control; for all other dependent variables they were not significantly different.

The location of the clinic, whether On-base or Off-base, was not significant for any of the dependent variables. However, OCONUS bases were significantly different for four of the six dependent variables though in different directions. OCONUS was 2.18%, 1.77%, and 5.3% lower than CONUS for HbA1C Screening, LDL-C Screening and LDL-C Good Control but 6.18% higher for Retinal Exams. Similarly, Primarily AD clinics were significantly different for all but LDL-C screening, coming in higher for three variables—12.31% for Cholesterol Screening, 6.6% for Retinal Exams and 4.78% for HbA1C Poor Control—but lower for the other two—4.11% for HbA1C Screening and 8.21% for LDL-C Good Control.

Table 25: Differences-in-Differences for Chronic Care Measures

	Cholesterol Screening			Retinal Exam			HbA1C Screening			HbA1C Poor Control			LDL-C Screening			LDL-C Good Control		
	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig	Diff	95% CI	Sig
Army	Ref			Ref			Ref			Ref			Ref			Ref		
Navy	.1	-2.3, 2.4	.966	-.2	-1.9, 1.6	.862	.2	-1.2, 1.6	.748	-.4	-2.2, 1.4	.662	<.1	-1.6, 1.5	.969	1.9	-.1, 3.9	.064
Air Force	-6.9	-9.3, -4.4	<.001	5.1	3.2, 7.0	<.001	-.2	-1.7, 1.4	.826	-1.8	-3.8, .2	.083	-.7	-2.4, 1.0	.420	4.5	2.3, 6.8	<.001
Pre	Ref			Ref			Ref			Ref			Ref			Ref		
Post	.2	-1.9, 2.3	.832	-2.0	-3.6, -.5	.008	2.6	1.4, 3.7	<.001	-1.7	-3.3, -.2	.031	1.5	.2, 2.9	.024	-2.3	-4.0, -.5	.011
Navy Diff-in-Diff	5.5	2.4, 8.6	.001	-.4	-2.7, 1.8	.703	.4	-1.4, 2.2	.662	-.6	-3.0, 1.7	.604	1.4	-.6, 3.4	.174	4.1	1.5, 6.7	.002
AF Diff-in-Diff	6.1	3.2, 8.9	<.001	-.1	-2.4, 2.2	.928	.2	-1.6, 2.0	.805	-.6	-3.0, 1.8	.616	.8	-1.2, 2.8	.417	2.8	.2, 5.4	.037
Large	Ref			Ref			Ref			Ref			Ref			Ref		
Medium	-.3	-1.9, 1.3	.711	-3.1	-4.4, -1.8	<.001	.8	-.2, 1.8	.117	.5	-.8, 1.8	.442	1.0	-.1, 2.1	.085	<.1	-1.4, 1.5	.953
Small	.3	-1.5, 2.1	.750	-2.5	-4.0, -1.1	.001	.3	-.9, 1.4	.667	1.6	.1, 3.1	.042	.7	-.7, 1.9	.328	-1.0	-2.7, .7	.249
On-base	Ref			Ref			Ref			Ref			Ref			Ref		
Off-base	.2	-2.5, 2.8	.910	.4	-1.4, 2.2	.667	.4	-1.1, 1.8	.640	.1	-1.8, 2.0	.890	.9	-.8, 2.5	.293	-.8	-2.8, 1.4	.485
CONUS	Ref			Ref			Ref			Ref			Ref			Ref		
OCONUS	.3	-3.5, 4.2	.863	6.2	4.9, 7.5	<.001	-2.2	-3.2, -1.1	<.001	-.7	-2.1, .6	.297	-1.8	-2.9, -.6	.003	-5.3	-6.8, -3.8	<.001
Not Primarily AD	Ref			Ref			Ref			Ref			Ref			Ref		
Primarily AD Patients	12.3	3.2, 21.5	.008	6.6	4.9, 8.3	<.001	-4.1	-5.5, -2.7	<.001	4.8	3.0, 6.6	<.001	-1.1	-2.6, .5	.179	-8.2	-10.2, -6.2	<.001
Adjusted R Squared	.160			.157			.084			.042			.034			.166		
F	14.5		<.001	22.8		<.001	11.8		<.001	6.1		<.001	5.1		<.001	24.3		<.001

Diff – Absolute percent difference from the reference group
*HbA1C Poor Control is a negative indicator—lower is better

DISCUSSION

The results of our analysis are mixed across the study period and branches of service. Interestingly, both the Navy and Air Force improved Cholesterol and LDL-C Good Control outcomes relative to the Army over time. Because the results show that the increases in absolute magnitude were small, especially for LDL-C Good Control, clinical significance is uncertain.

While five of the six measures are significant between the Pre and Post-PCMH periods, our results are also mixed with three measures declining and only two increasing. Again, though statistically significant, the change in percentage is small (<3%) that there may be little clinical meaning. There are many factors which may have led to these results. It is possible that the period captured was not long enough to allow PCMH to fully mature. Nielsen et al., indicated that "the trend…suggests that the longer the PCMH program had been implemented and subsequently evaluated, improvements in cost or utilization were demonstrated" (2016, p. 28). While our measures were neither cost nor utilization, it stands to reason that quality measures would follow the same trends.

While the MHS has wholeheartedly embraced the PCMH concept and model, one of their primary difficulties in implementation is the transitory nature of not only their patient base, but also their providers. Active Duty military members tend to move every three to four years, though that can vary depending on the individual and whether the member is enlisted or an officer. Anecdotal evidence shows that it is possible for an Air Force enlisted member to remain at one location for 10 years or more; however, the same cannot be said of officers. Because all providers, whether Medical Doctor, PA or NP, as well as nurses, are officers, the more typical time on station is 3 to 4 years (Tilghman, 2015).

The Army seeks to keep their soldiers at an assignment for 48 months but data from 2009 to 2014 shows that at least half of Army officers moved before 35 months (Tilghman, 2015). Navy assignments are only 36 months and they are closer to their aim with approximately half of officers moving around 33 months (Tilghman, 2015). In 2009 the Air Force changed its stated assignment length from 36 months to 48 months but time on station for officers has fallen since that time from 43 months to 37 months (Tilghman, 2015). The Marine Corps is the closest to meeting their goals with a time on station requirement of 36 months and at least half of the moves coming around 35 months (Tilghman, 2015). However, Marines do not man medical clinics because their medical needs are met by the Navy.

This continual, rapid movement of personnel, particularly providers, gives physicians and advanced practice providers little time to build a true medical home. For active duty manned clinics this can be partially ameliorated through maintaining the enlisted personnel for a longer duration in the same clinic and on the same medical home team. As discussed in the measures section, some civilian manned clinics have also been created. Our analysis indicates that there is no significant difference between military manned and civilian manned clinics. It is possible that the movement of patients has more impact on the medical home than expected. Another possibility is that civilian manned clinics do not retain their staff because the healthcare workers attracted to a military clinic may be as mobile as the people they treat.

Limitations

Many of the limitations of this study were detailed in the previous chapter, for example, it is possible that there are other quality improvement initiatives that were not captured in this study. Also, there was some lead time to PCMH implementation which may have influenced quality measures, and it may be that not enough time elapsed for PCMH to mature enough to have a significant impact. Other limitations include the unique aspects of the MHS which may not make the results generalizable to civilian healthcare networks. One of these unique aspects is the mobility of the military healthcare work force, something not commonly found in most primary care medical practices. This mobility is found at all levels from the medical technicians, to the providers, to the executive leadership. Not only are the healthcare workers subject to frequent moves but the beneficiaries themselves suffer from the same requirements. This mobility has not been accounted for in this study.

There may be unaccounted for clustering effects due to the relationship between the PCMH practicing clinics and the MTFs to which they belong. Unfortunately, our data did not provide enough detail to completely describe the MTFs. The linear model used in this study does not account for clustering though it may provide similar estimation results as a mixed effects hierarchical model.

Another limitation in finding statistically significant differences could lie with the already high HEDIS scores for these chronic care measures. HEDIS metrics were already a focus in the MHS and so may have created a 'ceiling effect' in our pre-PCMH data. The PCMH implementation may have had little room for improvement in the already excellent approach to screening and controlling these specific measures.

CONCLUSION

In conjunction with our previous study examining the effect of PCMH on preventive care measures in the MHS, it appears that PCMH has had little effect on quality of care metrics in both preventive and chronic care. However, the measures assessed in this and the previous study are far from the only possible measures and it is possible that the PCMH model has not yet had a significant impact on quality of care. Further research should be carried out to evaluate, not only other preventive and chronic care measures, but also cost and utilization metrics. The benefits of the PCMH model may be found in other areas.

CHAPTER 5: POLICY IMPLICATIONS

The MHS has a vested, long term interest in providing high quality primary care to its beneficiaries. The primary charge of the MHS is to keep the soldiers, sailors and airmen healthy so they can carry out their military mission (MHS, n.d.). The MHS is also responsible for ensuring military medical personnel are prepared to provide healthcare in an operational environment and to provide a medical benefit to military dependents and retirees (MHS, n.d.). From the high HEDIS metrics presented in this dissertation it appears that the MHS is providing quality care to its beneficiaries. Whether these high rates are due to a focus on HEDIS metrics or the military culture is unclear. We recommend that they continue tracking these metrics, making changes as appropriate to adhere to relevant practice guidelines.

With the already high percentage scores for these specific HEDIS metrics, it may have been difficult to achieve significant improvement in these measures with the implementation of the PCMH model. However, improvement may be found through analysis of cost and utilization measures. Suggested utilization measures include emergency department visits as well as ambulatory care-sensitive and all acute inpatient admissions (Rosenthal, Abrams & Bitton, 2012). Christensen et al. (2013) found that PCMH implementation had decreased emergency department visits by 6.8% at the Walter Reed PCMH however it has yet to be shown whether this rate holds true across the entire MHS. Analysis of the variance in utilization between the branches of service may show differences in PCMH implementation.

It is less clear, particularly in the MHS environment, what cost measures should be analyzed. Rosenthal, Abrams and Bitton (2012) suggest total per member per month costs and total per member per month costs for high-risk patients as appropriate measures. In the Walter Reed PCMH study Christensen et al. (2013) considered pharmacy costs, ancillary costs and per member per quarter costs. Flieger (2017) utilized claims based total costs excluding pharmacy reported per 1000 member-months. Some combination of these measures should prove adequate to analyze the impact of PCMH on costs in the MHS across the branches of service.

Another area of analysis that should be considered is the impact of provider continuity on the PCMH model. An ongoing relationship with a personal physician is one of the primary tenets of PCMH (Arend et al., 2012; Hudak et al., 2013) however the continual movement of both primary care providers and patients can make the development of this relationship difficult. Further study of the impact of the relationship with a personal physician is warranted. The results of such a study may indicate that perhaps it is time to question whether the movement of primary care providers is in the best interests of the MHS.

A study by Calman et al. (2013) suggests that longer-term analyses of PCMH may have merit. As it has been 10 years since the first PCMH pilot programs in the Army, Navy and Air Force and only slightly less since PCMH implementation across the entire MHS, a longer-term study may show significant differences. This longer time-line should be used for analysis of the utilization, cost and continuity measures already recommended and could also be utilized for a new analysis of the quality measures contained in the essays of this dissertation.

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