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Evaluation of an Innovative Program to Improve Outcomes among Military Beneficiaries with Diabetes

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EVALUATION OF AN INNOVATIVE PROGRAM TO IMPROVE OUTCOMES AMONG MILITARY BENEFICIARIES WITH DIABETES

by

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Abstract

EVALUATION OF AN INNOVATIVE PROGRAM TO IMPROVE OUTCOMES AMONG MILITARY BENEFICIARIES WITH DIABETES

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Patient Centered Medical Home (PCMH) is a health care model implemented in all United States Air Force (USAF) medical facilities which uses a team-based approach to promote accessibility, quality care, and appropriate service utilization, while decreasing costs. To measure the effectiveness of this model, the National Committee for Quality Assurance (NCQA) has developed a tool to document and recognize facilities that incorporate all model elements. However, the effects of the full model implementation on patient outcomes in military settings have not been studied. This research fills an important gap in the literature because it studies the effect of PCMH implementation in military settings, which has been mandated by the Assistant Secretary of the Defense. The five-phase implementation plan for PCMH in the USAF was described in the first manuscript. The second manuscript specifically identifies the hypotheses studied, the methods for data collection and analysis, and provides a synthesis of results. This study evaluates the effects of PCMH implementation on patients with type-2 diabetes (T2DM) in military clinics. This study also explores whether NCQA Provider Practice

Connections®-Patient Centered Medical Home™ (PPC®-PCMH™) recognition scores, based upon the standards of the PCMH, explain variations in glycated hemoglobin levels (*HgA1c*), emergency department *(ED) visits*, and *hospitalized days* among T2DM patients.

The results show support for the effect of PCMH implementation on *HgA1c* for patients with T2DM seen in military clinics. Support was mixed for PCMH having a positive effect on *hospitalized days* and *ED visits.* Evidence was not found for the ability of NCQA PPC®-PCMH™ recognition to explain variation in *HgA1c*.

Keywords: Patient Centered Medical Home, National Committee for Quality Assurance, NCQA PPC®-PCMH™ recognition, type-2 diabetes, chronic disease, chronic care model (CCM)

Chapter One: Overview of the Research Study

Significance Statement

The United States Air Force (USAF) embraced the Patient Centered Medical Home (PCMH) model as a primary care delivery redesign recommended by the Patient Centered Primary Care Collaborative to improve health care access, strengthen provider-patient relationships, and improve care comprehensiveness and coordination (American College of Physicians, 2007). Recently passed federal legislation for universal health care, HR-3590: Patient Protection and Affordable Care Act, included recommendations for PCMH demonstration projects (U.S. Congress, 2010). The ultimate goals are improved access and improved public health.

The USAF implemented the PCMH model worldwide, and recent evaluations have assured that program implementation effectively incorporates all model elements. Those recent evaluations involved initial clinician group self-assessments and subsequent evaluation by trained external evaluators who awarded program recognition status once all elements were effectively incorporated. Now it is time to see if patient outcomes have improved as a result of the considerable time and expense involved in this major health care system delivery redesign. This study evaluates whether or not patient outcomes improve in one diagnostic group, patients with type-2 diabetes mellitus (T2DM), as a result of PCMH implementation. It compares their health outcomes before the program redesign to their outcomes after USAF program implementation and NCQA recognition status.

Purpose of the Research Study/Problem Statement

In the USAF, PCMH has been embraced as a way to decrease fragmentation and promote proactive care that acts in anticipation of patients' future problems, needs, and changes. Access to care is balanced with health promotion, disease prevention, early detection, and condition management. PCMH became the USAF Surgeon General's standard model of primary care that is intended to be pleasing to both patients and medical staff alike (Marshall et al., 2011). Thus, the PCMH model was introduced as a primary model of reform for the military health care system, prioritizing the goals of civilian implementation, improved quality of health care, better patient experience, and ultimately reduced spending for better health care (Marshall et al.).

Prior to implementation of the PCMH model, the USAF used the Primary Care Optimization (PCO) model. In the PCO care delivery system, continuity was challenging, patient education rather than self-management was emphasized, and telehealth management presented a large burden on PCO nurses rather than providing opportunity for face-to-face clinical care. By contrast, PCMH prioritizes a strong primary care foundation giving each patient a *medical home* and regular health care provider, with a focus on health care organization, practice redesign, clinical information systems, decision support, and self-management support. Thus, the PCMH model was expected to promote continuity between patient and team, improve patient engagement and involvement, and prioritize the goal of providing a patient with the right level of care at the right time. Such care was expected to be more organized, less fragmented, and yield better patient health outcomes. Telehealth management is an element, but not

intended to be a primary means of patient interaction with their health care team. The ultimate goal, not addressed by this study, is reduced overall health care costs.

Among all chronic diseases, type-2 diabetes is of great concern. The number of patients with diabetes in the U.S. has doubled in the last 2 decades, with 8.3% of all Americans having diabetes (Centers for Disease Control [CDC], 2011). This translates to 25.8 million people who are diagnosed with the disease, with an estimated 7.0 million more that remain undiagnosed (CDC, 2011). Yet only half of the recommended care for chronically ill patients actually takes place (Improving Chronic Illness Care [ICIC], 2012a). T2DM is a problem for the U.S. military. While chronic disease, and specifically T2DM, is less prevalent among active duty military members who must be "fit to fight," it is common among military retirees and dependents of both active duty and retired members with rates similar to the civilian population (Paris, Bedno, Krauss, Keep, & Rubertone, 2001). Thus, this study aimed to evaluate the impact of the PCMH model among T2DM patients who received care in military clinics.

From Medical Home to PCMH

Alexander and Bae (2012) published a synthesis (grant supported by Robert Wood Johnson) of 61 research studies involving the PCMH model. They organized the studies into four areas: 1) access to care, 2) service utilization, 3) patient satisfaction, and 4) multiple outcome evaluations. Many of the reviewed studies used the term *medical home* loosely and did not involve implementation of all components of the model. The formal PCMH model will be discussed later in this proposal, and involves six elements. The model complexity poses challenges to implementation and thus creates the fundamental issue in the research literature thus far. The majority of studies are yielding

positive results, but they evaluated partial PCMH model implementation scenarios, and that inconsistent use of the model undermines insight into the impact of full program implementation on access, services, satisfaction, and outcomes.

A case in point is the prior review of medical home evidence that primarily focused on comparing access to a consistent primary care provider versus access to a site for care (Starfield & Shi, 2004). *Primary care* was used as a synonym for *medical home,* and no mention was made of the *Patient Care Medical Home* model. The authors concluded that the relationship between the consistent provider and the patient was more important than simply having access to a medical home. But at that point, studies often viewed a medical home as a yes/no access scenario, even though the concept of a medical home was viewed as having four elements: access, person-focused care over time, comprehensive care, and coordination of care by one key care provider for each patient. So the review included studies purported to involve the medical home, but many of the studies did not validate that the four key elements were present or consistently incorporated. That review reflects the thinking at the time which was that having a primary care physician available when care is needed (both preventative and problem-focused) constituted having a medical home.

A subsequent review of medical home evidence from 33 studies (Homer et al., 2008) included the term *Patient Centered Medical Home model* but still reflected the national attention to the impact of having access to primary care (or a medical home) on health outcomes. Eighteen of the studies involved pediatric populations, 16 were cross-sectional design, 6 were randomized controlled trials (RCTs), and inclusion criteria were not strict in allowing inclusion of studies involving only 1 or 2 elements of a medical

home. Of the 6 RCT studies, all involved pediatric populations that varied from incorporating 2 elements (Broyles et al., 2000; Lozano et al., 2004) to 5 elements (Homer et al., 2005; Stein & Jessop, 1991), and 3 were done in the 1990s (Jessop & Stein, 1994; Stein & Jessop, 1991; Smith, Layne, & Garell, 1994) before either the CCM or PCMH had been well articulated in the literature. Results were generally positive and supported the value of a medical home. According to Homer el al. (2008),

> Outcomes with the most compelling positive results included family centeredness, effectiveness, timeliness, health status, and family functioning. Inconsistencies in the definition of MH (medical home) activities and in the assessment of outcomes preclude our ability to answer the second study question of whether programs undertaking more activities have better outcomes than programs undertaking fewer such activities. (p. e934)

Thus, the elements of a medical home and a formal model for practice were needed to direct care.

The formal model, termed the Patient Centered Medical Home model, was introduced by the American Academy of Pediatrics (AAP) in 1967 and initially referred to a central location for archiving a child's medical record. The AAP expanded the concept in 2002, and it was then adopted by the American Academy of Family Physicians in 2002 as part of the Future of Family Medicine project (Kahn, 2004). Joint Principles of the Patient Centered Medical Home were published in February 2007 (Patient Centered Primary Care Collaborative [PCPCC], 2007), and included seven principles: a personal physician/provider, a physician-led medical practice, whole person orientation, coordinated/integrated care, an expectation of quality and safe care, enhanced

access to care, and payment reform. This primary care model was designed to improve access, strengthen the relationships between providers and patients, and deliver comprehensive care with coordination among providers (Berenson et al., 2008).

The PCMH model is based upon the chronic care model (CCM) (PCPCC, 2007). The CCM is a framework for management of chronic health conditions devised by Ed Wagner of the MacColl Institute, which includes six elements (Wagner, 1998). Later, the National Committee on Quality Assurance (NCQA) used the CCM as its basis to develop a tool, the Physician Practice Connections® (PPC)-PCMH™ to evaluate implementation of the PCMH (NCQA, 2008). This tool was comprised of 9 standards and 30 elements. This evolution is confusing because of the varied names and acronyms (medical home, CCM, PCMH, elements, and standards) and findings reported on the varied models without clear insight into what elements of the model were included.

Table 1 provides a quick overview of the seven joint principles identified by the Patient Centered Primary Care Collaborative (PCPCC), the six elements of the chronic care model (CCM), and the nine standards of the NCQA PPC®-PCMH™ recognition tool. The seven joint principles of the PCPCC and the nine standards of NCQA PPC®-PCMH™ recognition are based on the theoretical model of the CCM. Table 1 shows the consistency and relatedness of principles, standards, and elements of each. NCQA PPC®-PCMH™ standards are comprised of sub-standards referred to as elements. Selected elements are viewed by NCQA as absolute requirements for recognition—those selected elements are referred to as "must-pass" elements. There are a total of 30 elements that are part of the nine NCQA PPC®-PCMH™ standards, but only the six "must pass" elements are included in Table 1 for visibility and comparison.

Table 1
Comparison of the PCPCC, CCM, and NCQA PPC®-PCMH™ Elements

PCPCC Elements	CCM Elements	NCQA PPC®-PCMH™ 2008 Standards and "Must Pass Elements"
1. Personal physician 2. Physical-directed medical practice 3. Whole person orientation 4. Coordinated/ integrated care 5. Quality/Safety 6. Enhanced access 7. Payment restructure	1. Health System 2. Delivery System Design 3. Decision Support 4. Clinical Information Systems 5. Self-Management Support 6. The Community	**PPC1**: Access and Communication Element A: Access and Communication Processes Element B: Access and Communication Results **PPC2**: Patient Tracking & Registry Functions Element D: Organizing Clinical Data Element E: Identifying Important Conditions **PPC3**: Care Management Element A: Guidelines for Important Conditions **PPC4**: Patient Self-Management Support Element B: Self-Management Support **PPC5**: Electronic Prescribing Element A: Electronic Prescription Writing Element B: Prescribing Decision Support—Safety Element C: Prescribing Decision Support—Efficiency **PPC6**: Test Tracking Element A: Test Tracking and Follow-Up **PPC7**: Referral Tracking Element A: Referral Tracking **PPC8**: Performance Reporting & Improvement Element A: Measures of Performance Element C: Reporting to Physicians **PPC9**: Advanced Electronic Comm.

Varied Use of Elements Hinders Insight

Studies show generally positive results of the CCM in practice, but varied use of the program elements (rather than consistently using all of the CCM elements), and results more often involving pediatric, rather than adult populations, undermine internal and external validity of the findings.

Casalino et al. (2003) surveyed 1,040 physician organizations (each with 20 or more physicians) concerning their use of case management, physician feedback, a disease registry, use of clinical practice guidelines, and patient self-management skills, which are consistent with the CCM and PCMH. They found that the average organization had only 5 out of 16 of those elements. Of the four processes specific to diabetes care, only one third of the medical practices used at least three model elements, and half used only one or none.

Goldberg and Kuzel (2009) validated that complete implementation of the PCMH model is rare. Their evaluation of 342 family medicine offices in Virginia found that only 1% of practices exhibited all elements outlined in the PCMH model and that practice size was significantly related to PCMH model alignment. They found that most family practices exhibited some elements of the PCMH model, with continuity-of-care processes (87%) and clinical guidelines (77%) being the most commonly used. Fewer practices reported the use of patient surveys (48%), electronic medical record for internal coordination (38%), community linkages for care (31%), clinical performance measurement (28%), and patient registries for multiple diseases (19%).

Dorr et al. (2006) reported on a PCMH demonstration project that evaluated important elements of the CCM (the electronic medical record and case manager), and the six model elements in a care delivery system of seven clinics (n = 106,766 patients). Almost all practices (97.9%) utilized three or more elements of the PCMH model, and 49.2% utilized at least seven of the elements of the PCMH model. Practice size was significantly related to total PCMH elements (suggesting larger practices incorporated

more or all of the PCMH elements), and larger practices incorporated the elements of quality and safety, medical team, and coordination of care.

The Chronic Care Model and Diabetes

Dorr et al. (2006) also examined clinical outcomes and provider satisfaction. Their investigation revealed that patients with diabetes were more likely to be on time for *HgA1c* testing, with a 0.55% reduction in *HgA1c* compared to only 0.18% reduction in controls. Almost 89% of physicians were satisfied with the program and were able to increase productivity 8%, compared to 5.5% in other clinics. Additionally, the CCM reduced *HgA1c* and *hospitalizations* among patients with diabetes, and improved patient and physician satisfaction (Dorr et al., 2006).

Solberg et al. (2006) studied the CCM and found improvements in care quality for diabetes, coronary heart disease, and depression correlated with use of the CCM adopted in 17 primary care clinics. Numerous studies have further documented that chronic disease management reflecting elements of the CCM improved the quality of care and outcomes for patients with various chronic illnesses, including diabetes. Siminerio et al. (2006) showed that use of the six elements of the CCM was effective in implementing and financially sustaining an effective diabetes self-management training program (n = 31,150). Parchman, Pugh, Wang, and Romero (2007) further showed improvement in *HgA1c* that was positively correlated to the number of CCM elements incorporated into care (n = 618).

An RCT of the CCM involving 119 adult diabetics in 11 general, family, and internal medicine civilian practices was done by Piatt et al. (2006). The practices and their patients were randomized, and three practices received CCM intervention (n = 30),

three received provider education (n = 38), and five (n = 51) received usual care. The results showed significant improvements in *HgA1c*, non-HDL cholesterol, and self-monitoring of blood glucose, with improvements also noted in HDL cholesterol, diabetes test scores, and empowerment scores (Piatt et al., 2006). A follow-up study showed that improvements in *HgA1c*, blood pressure control, and self-monitoring of blood glucose were maintained 3 years later (Piatt, Anderson, et al., 2010; Piatt, Songer, et al., 2010).

According to a Cochrane review, organizational and multifaceted professional interventions, such as those found in the components of the CCM and of NCQA PCMH recognition standards, enhance the management of patients with diabetes (Renders et al., 2001). Multifaceted interventions include process flow sheets that are part of clinical information systems, clinician reminders that are part of decision support, and risk factor screening that is part of self-management support. Professional interventions are not limited to those of the provider, but rather emphasize the use of primary care teams as part of delivery system redesign. Multi-disciplinary teams are a key part of USAF PCMH implementation as prepared, proactive practice teams.

Military Research

While these studies demonstrated results, none were specifically designed to study military health care. At the same time that the CCM and PCMH models were evolving, the military was implementing nationally recommended clinical practice guidelines designed to improve care. Lesho (2005) studied the use of clinical practice guidelines for asthma, diabetes, and tobacco in military treatment facilities (n = 68,000). Lesho found that incorporating more patient-oriented interventions through the use of

clinical practice guidelines significantly improved two of eight diabetic care process measures, but did not improve the patient outcome of *HgA1c*.

McCraw, Kelley, Righero, and Latimer (2010) also studied clinical practice guideline use among patients with T2DM at military treatment facilities (n = 123). In their study, disease management improved process measures of compliance with *HgA1c* lipid and blood pressure testing, plus annual foot checks. Use of clinical practice guidelines also improved outcome measures of *HgA1c* and lipid control. Neither of these two studies in military populations on guidelines compliance included the larger scope of practice re-design that is part of PCMH, based on the CCM, but both highlighted the benefit of more patient-centered care.

Growing U.S. Buy-in to PCMH

While the PCMH model grew out of years of pediatrician focus on the benefits of a medical home, a myriad of other professional groups and state health departments were embracing the PCMH model as a viable solution to many of the problems facing the U.S. health care system. The National Center for Medical Home Implementation, a website sponsored by the AAP, was devised as a resource for the various federal and state demonstration projects to test the PCMH model (http://www.medicalhomeinfo.org/). Currently, most states have projects underway to implement the medical home, and those efforts led to a call for tools to evaluate how well the PCMH standards and elements are put into practice.

The U.S. National Center for Quality Assurance is a non-profit, private organization that evaluates health care quality. That organization devised a method to evaluate PCMH model elements and the extent to which they are incorporated into

care (NCQA, 2008). That evaluation was termed the NCQA Physician Practice Connections® (PPC)-PCMH™. Subsequent studies were done using the tool to establish convergent validity and also determine the extent of the use of the standards and elements in practice. A cross-sectional survey of medical directors of large (> 100 physicians) medical groups (n = 111) conducted by Solberg et al. (2009) showed a correlation between NCQA PPC®-PCMH™ score and the presence of practice system elements of the CCM. Both PCMH and NCQA PPC®-PCMH™ standards are based on the CCM (NCQA, 2008). Solberg, Asche, Pawlson, Scholle, and Shih (2008) showed that NCQA PPC®-PCMH™ scores correlated with process and outcome measures of diabetes quality among medical groups in Minnesota (n = 40).

PCMH Impact on Health Care Costs and Staff

Considerable focus nationally is on how the PCMH model impacts health care costs. NCQA PCMH recognition lowered costs for complex patients (n = 65,905) at a large civilian health plan in Minnesota. High NCQA recognition scores were associated with lower *outpatient* costs, but the impact of increased PPC scores upon *inpatient* costs was small and not statistically significant (Flottemesch, Fontaine, Asche, & Solberg, 2011).

Reid et al. (2009) evaluated the effect of PCMH implementation on patient experience, staff burnout, quality, utilization, and costs at 20 primary care clinics in western Washington State (n = 236,604). Staff burnout (report of high emotional exhaustion) at 12 months was 10% of PCMH staff compared to 30% of controls, despite similar levels at baseline. Change components (such as email and calls to primary care team) were used more by PCMH patients than controls, and composite quality (such as

appropriate care processes for patients with chronic disease) was 1.2%-1.6% greater than non-PCMH patients. In addition, PCMH patients utilized 29% fewer emergency department (*ED*) visits. Inpatient admissions did not differ significantly between PCMH patients and controls, but PCMH patients had 11% fewer hospitalizations for ambulatory care sensitive conditions.

A follow-up study by Reid et al. (2010) showed improvements in patient experiences, quality, and decreased clinician burnout over a period of two years. Compared to controls, patients in a PCMH experienced 29% fewer *ED* visits and 6% fewer *hospitalizations*, with a total savings of $10.30 per patient per month after 21 months.

The PCMH is based on the Chronic Care Model, which is endorsed by numerous physician groups including the National Quality Forum (in 2008) as the Medical Home System Survey (National Quality Forum, 2011). But, as noted earlier, studies in civilian health care systems (there are lots of civilian studies on PCMH, but very few studies on military populations) have shown that most practices have not implemented all the components of the PCMH. No studies were found reporting the extent of implementation among military practices. The limited studies are not surprising since the PCMH model can be challenging to implement, especially in areas that require considerable financial and knowledge resources such as electronic medical records (EMRs) and performance measurement for clinical activities. Initial reports were very encouraging with positive outcomes of reduced *hospitalization* rates, reduced *emergency department* visits, and increased savings per patient in several civilian medical home demonstrations. These

findings contributed to growing enthusiasm about the ability of the CCM to profoundly improve U.S. health care and reduce soaring costs.

Theoretical Framework

As noted earlier, the PCMH model is based upon the Chronic Care Model (CCM), developed by Edward H. Wagner of the MacColl Institute (Glasgow et al., 2002; Wagner, 1998). The CCM identifies elements required for a system-based model to be effective for chronic disease management: patient self-management support, clinical information systems, delivery system redesign, decision support, and health care organization and community resources (ICIC, 2012b). A graphic presentation of the model is shown in Figure 1 (Wagner, 1998).

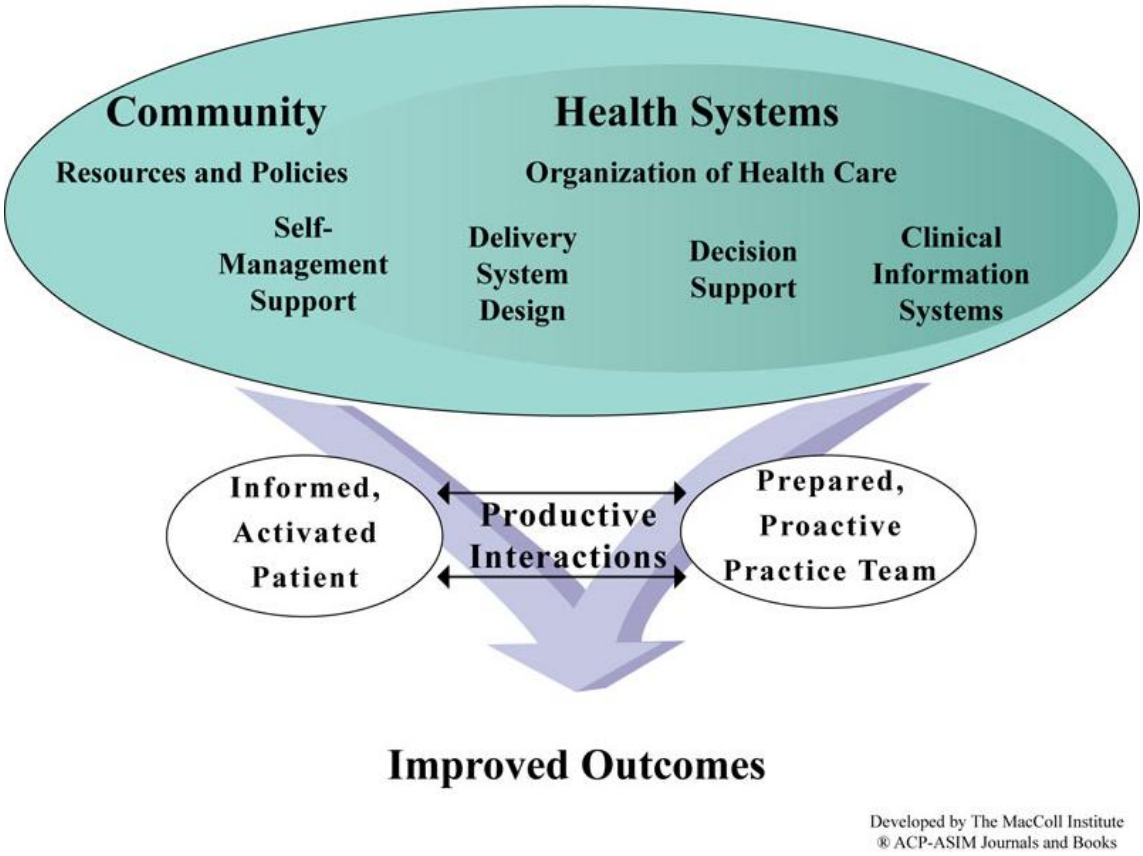

Figure 1. The Chronic Care Model

The Chronic Care Model illustrates the organization of Health Systems interacting with Community (resources and policies) that lead to productive interactions. This is best facilitated by an informed, activated patient and a prepared, proactive practice team (Wagner, 1998). Permission to use the diagram of the CCM was granted by a representative from the *Annals of Internal Medicine* (see Appendix A).

The CCM combines the organization of health care practices with the resources and policies of the community which yield productive interactions between prepared, proactive practice teams and informed, activated patients. The organization of health care is broad and is the primary area of practice redesign for the USAF. It includes delivery system design, decision support, and clinical information systems.

Delivery system design includes the important elements of appointment access, pre-visit planning (team "huddles"), and missed appointment follow-up. Decision support includes clinical guidelines, preventive services according to clinical guidelines, abnormal test protocols and alerts, clinician reminders for care, preventive services, risk assessments, and counseling. Clinical information systems include disease registries for chronic disease that are being followed, such as a registry of all patients with diabetes, hypertension, or asthma. Information systems also include process flow sheets, checklists of interventions, patient assessment questionnaires, clinical test tracking, referral tracking, and use of an electronic medical record. All of those aspects of the organization of health care are expected to lead to a prepared, proactive, practice team.

The patient is put in the context of the community and given resources to aid in self-management support, such as patient reminders for care and preventive services, individualized patient education, risk factor screening, self-management materials and

programs, and the opportunity for electronic communication between patient and provider. Such support leads to an informed, activated patient, who is then ready to interact with the proactive practice team in productive interactions that result in improved patient outcomes.

The CCM is the basis for PCMH implementation. The ICIC website identifies key features of a PCMH as "change concepts" (ICIC, 2012a). Such concepts are general ideas, with proven merit and sound scientific or logical foundation to stimulate specific ideas for changes that lead to improvement. PCMH change concepts include the following:

Engaged leadership. Visible leaders that provide overall culture change, guide the effort of quality improvement teams, ensure health care team members have protected time for conducting activities consistent with PCMH, and utilize medical home values in staff hiring and training processes.

Quality improvement strategy. The facility uses formal models for quality improvement, monitors established metrics to evaluate improvement efforts, obtains feedback from patients about their experience, and optimizes the use of health information technology to schedule appointments, monitor access to care, understand their populations, track care of patients, provide patient education materials and care reminders.

Empanelment. The facility determines which patients should be empanelled in the medical home, uses registries to proactively contact, educate, and track patients by disease status/ risk status, understands practice supply and demand and is able to balance patient load accordingly.

Patient-centered interactions. These practices assess patient values and needs, encourage patients to expand their role in decision-making, health-related behavior changes, and self-management. In addition, patient centered interactions communicate with patients in a culturally appropriate manner (i.e., in a language and at a level that the patient understands), providing self-management support at every visit through goal setting and action planning.

Organized, evidence-based care. Planned interactions are used according to patient needs. "Standing orders" are available before any interaction. Point-of-care reminders based on clinical guidelines are used.

Care coordination. Patients are linked with community resources to facilitate referrals. Care management services are provided for high-risk patients. Behavioral health and specialty care delivery are integrated into practice. Services that occur outside the practice are tracked, with a follow-up after *ED visit* or hospital discharge occurring within a few days and test results communicated to patients and families.

Enhanced access. Patients have continuous access 24/7 to their care teams via phone, email, or in-person, and scheduling options are patient centered.

Continuous and team-based healing relationships. Practices clearly link patients to a provider and care team, assure that patients are able to see their provider or team whenever possible, define roles and distribute tasks among care team members to reflect their skills, abilities and credentials, and cross-train care team members to maximize flexibility.

Health care organization refers to efforts that the facility takes for continuous performance measurement and the formal quality improvement activities utilized by the

military treatment facilities. The USAF has developed performance metrics to measure accessibility and continuity of PCMH. Delivery system redesign includes key elements of the patient having access to clinic appointments when needed, a system that provides for booking patients with the provider they are enrolled to, team "huddles" to use for pre-visit planning, after visit follow-up, and follow-up for missed appointments. It also includes a non-MD educator, which, for the USAF, is usually a disease manager nurse. The disease manager is devoted to following the population of patients with a designated disease, for example, the population of patients with T2DM. The disease manager is usually the staff member to provide after visit follow-up or missed appointment follow-up. That person is also typically the staff member to track clinical tests and referrals, and to ensure appropriate test dates and results are entered into the patient registry.

Much of "delivery system redesign" was not part of PCO. The difference in practice redesign on this element alone is significant. The scheduling and appointing process was changed under PCMH to not allow cross-booking, thereby aiding in continuity. Clinical information systems refer to the use of a disease registry, such as the registry, or list, of patients with T2DM, hypertension, or asthma. Registries for tracking patients with T2DM, for example, were non-existent under PCO. Under PCMH, those registries track appointment dates, lab results, and annual exams required by clinical practice guidelines. These systems also include practical tools, such as problem lists, medication lists, process flow sheets, having an electronic medical record (EMR), and tracking clinical tests and referrals. Decision support refers to support to the provider and team regarding appropriate tests for each patient that is enrolled to that specific provider and team. It involves the use of clinical guidelines, preventive services, abnormal test

alerts and protocols, and clinician reminders for preventive services, risk assessments, counseling, and aspects of care.

Decision support also makes use of automatic reminders for the provider to be able to provide complete care according to recommended clinical practice guidelines. Self-management support refers to the patient being engaged in management of their own care. It includes self-management plans, materials, and programs, individualized patient communication, being able to communicate with the patient electronically, and provide the patient with reminders for care and for preventive services.

Measurement and evaluation of compliance to the CCM has increasingly used NCQA PCMH recognition since 2008. NCQA PCMH recognition includes a self-reporting tool submitted by primary care practices to NCQA for evaluation, based on scientifically sound performance measures around CCM concepts. It is an evaluation of a systematic approach to delivering preventive and chronic care (S. Harrington, personal communication, December 19, 2011). NCQA PPC®-PCMH™ has become the primary assessment device to judge medical homes (Solberg et al., 2009). NCQA's experience in scoring quality measures led to development of Standards and Guidelines for Physician Office link in 2003, and Standards and Guidelines for Physician Practice connections in 2004.

The standards for Physician Practice Connections®-Patient Centered Medical Home™ were developed in 2008 (NCQA, 2008). NCQA PPC®-PCMH™ 2008 recognition includes 9 standards, 30 elements, and 183 data points as a basis for recognition by practices as a PCMH. Practices were eligible to apply for PCMH Recognition under 2008 PPC®-PCMH™ Guidelines if they submitted by December 2011.

NCQA enhanced its PCMH standards and released updated PCMH 2011 standards January 31, 2011. Applications submitted after December 31, 2011 are evaluated based on the PCMH 2011 standards. Forty five military treatment facilities (15 each from Air Force, Army, and Navy) submitted applications for NCQA PCMH recognition based on NCQA's PPC®-PCMH™ 2008 standards. The 15 Air Force facilities that applied for NCQA PCMH recognition were all chosen based on their robust PCMH implementation. For this study, when NCQA PCMH recognition is discussed, it will be in reference to PPC®-PCMH™ 2008 rather than PCMH 2011 standards, except where otherwise noted.

Introduction of Articles

Chapter 2, Manuscript 1 describes the process that the U.S. Air Force followed for implementation of PCMH in all of its medical treatment facilities (MTFs). It was a multi-phase process that began with implementing PCMH at a few MTFs as pilot programs, then developing a multi-disciplinary team to visit sites ahead of and on their implementation date to educate staff on required process changes, and then providing follow-up guidance and assistance via teleconference after implementation occurred. The USAF process also provided on-site visits from senior health care leaders, including General Officers, to emphasize the importance of the program, promote sustainment through monitoring metrics and measures of success, and rewarding change through incentives for successful MTFs. The final phase of implementation included application for NCQA PPC®-PCMH™ recognition to ensure processes for delivery redesign stayed in place. The USAF selected 15 sites to apply for formal NCQA recognition as they had early and robust PCMH success. All 15 USAF sites that submitted applications for

NCQA PPC®-PCMH™ recognition achieved Level 3 Recognition status, the highest level possible.

Chapter 3, Manuscript 2 is a report of original research carried out to determine the effect of PCMH implementation on specific outcomes for patients with type-2 diabetes mellitus (T2DM) at those 15 military facilities. The research was a quantitative study using retrospective secondary data from the USAF electronic medical record. Study design, population, methods, and results are described, along with implications for those results and recommendations for future research.

As mentioned earlier, previous studies of civilian practices had documented that complete implementation of the PCMH model is rare, with one study showing that only 1% of 342 family medicine offices exhibited all elements (Goldberg & Kuzel, 2009). PCMH implementation in the USAF was intended to comprehensively address all elements of the CCM, and NCQA PPC®-PCMH™ recognition was a measurement of how well that has been accomplished. Therefore, this study was designed to assess the effectiveness of PCMH on selected patient outcomes, to compare the effectiveness of PCMH implementation between sites, and to assess whether that effectiveness correlates to NCQA PPC®-PCMH™ recognition scores in military settings. This understanding helps inform the direction of future efforts for PCMH implementation across the entire AFMS, as well as stimulate recommendations for future research.

Chapter Two: Manuscript 1

Patient Centered Medical Home in the U.S. Air Force

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Patient Centered Medical Home in the USAF

The literature is replete with assessments of the U.S. health care system as expensive, fragmented, and challenged in dealing with the growing list of health care problems among a burgeoning, aging population. While there is broad agreement that the health care system is "broken" and needs to be reformed, there is little consensus on exactly how that reform should take place. One method that has met with some success in the civilian community is called the Patient Centered Medical Home (PCMH) model. Numerous studies have evaluated the success of various aspects of the model when implemented in civilian health care practice, but little has been written about PCMH in the military community. This article will review the activities involved in PCMH program redesign by the United States Air Force (USAF), as well as the processes and strategies used to address the challenges encountered.

The Patient Centered Medical Home model was introduced by the American Academy of Pediatrics (AAP) in 1967, initially referring to a central location for archiving a child's medical record (Improving Chronic Illness Care, 2011). The AAP expanded the concept in 2002, and it was adopted by the American Academy of Family Physicians in 2002. It was then endorsed by major primary care governing bodies, and in February 2007, the Joint Principles of the Patient Centered Medical Home were published as part of the Patient Centered Primary Care Collaborative (2007).

The Joint Principles of PCMH include a personal physician/provider, a physician-led medical practice, whole person orientation, coordinated/integrated care, an expectation of quality and safe care, enhanced access to care, and payment reform. This primary care model was designed to improve access, strengthen the relationships between

providers and patients, and deliver comprehensive care with coordination among providers (Berenson et al., 2008).

The military also embraced this model. Military health care faces many of the same challenges of the U.S. health care system in serving a large population of active and retired servicemen and their families. Unlike the general health care system, however, the military follows orders. Implementation of the PCMH model was mandated, and implementation was expected to occur in a defined time period of 4 years. Initial development of PCMH was in response to patient and staff concerns (Kosmatka, 2011).

Patients were concerned about the difficulty of getting an appointment, as well as the difficulty of being able to consistently see the same provider. Staff concerns of Air Force physicians included the desire to build continuity with their own patients, the need for adequate and consistent support staff, the desire for a currency-based practice rather than a business-based practice, and the desire for greater control over their own practice. "Currency-based" versus "business-based" practice refers to the need to remain current on trauma and critical care skills necessary to provide complex medical care for war injuries at deployed locations, in comparison to a business-based practice concerned with the right mixture of various types of appointments and securing accurate billing codes for those appointments. A significant stimulus was the exit of many family physicians from the USAF in response to a lack of control of how to manage their patients. There was also frustration felt by other staff members, including medical technicians who were not being used to the full scope of their practice and ambulatory care nurses concerned about their clinical practice being limited to telehealth with minimal direct contact with patients.

The USAF initially called its version of the model "The Family Health Initiative" when implementation began in August 2008, but adopted the PCMH nomenclature when the Assistant Secretary of Defense mandated implementation across all three branches of service in 2009 (Policy Memorandum, 2009). The goals of PCMH in the USAF are to create an enjoyable and productive practice environment, deliver world-class and evidence-based quality care, and, in the process, retain current staff, recruit new personnel, and maximize use of skills at all levels of clinic staff (Kosmatka, 2011). A focus on prevention, proactive rather than reactive care, and a greater emphasis on disease and case management are all hallmarks of the USAF's PCMH. The USAF embraced the PCMH model and invested in major system redesign to implement the program in all of its primary care sites in a phased-in approach through 2012.

Challenges and Concerns

As with any major program redesign, considerable staff training was required to implement the changes. Fortunately, the implementation was made easier by training, resources, and the oversight provided by an Air Force PCMH implementation team. Previous models, such as Primary Care Optimization and Clinical Practice Optimization, had limited success in the USAF due to several factors. One was the inefficient use of staff and lack of accountability, which limited the success of those models to the level of the medical treatment facility (MTF). Another factor was that MTFs were given unrealistic timelines for success. Therefore, the required metrics did not drive desired behavior, and the model was not given time to mature. In contrast to previous models, with PCMH, there is an expectation for MTFs to maximize patient involvement, use the entire health care team, maintain continuity of staff within teams, maximize continuity

between patient and provider, and communicate within teams utilizing tools such as huddles and routine care coordination team meetings.

Implementation

Implementation occurred in several phases. The **initial phase** treated the first few MTFs as pilot programs. After the pilot programs, implementation continued across the Air Force Medical Service.

The **second phase** involved subject matter experts on a multi-disciplinary team conducting site visits at MTFs where they reviewed processes and made recommendations to incorporate concepts of a Medical Home. The multidisciplinary team included a senior officer consultant, physician, nurse, group practice manager, and enlisted consultant for clinical and administrative functions. The team visited the MTF approximately eight weeks prior to the planned PCMH implementation date to describe the "ideal state" and to assist the MTF with planned process changes that would be required. A tracking tool was developed after the first visit, which was used to focus MTF efforts and provide accountability for needed actions.

Once the PCMH team made their first visit to the MTF, the real work began for that site. In addition to the PCMH team's implementation plan, there were additional actions required at each MTF which included process changes, training, and team building which were vital to the success of the program. The concept of daily team huddles was encouraged to communicate schedules, review the day's patients, and to foster an environment where staff could communicate openly with each other. Training was also essential, with key aspects including getting to know the capabilities of the medical technicians and the civilian staff. Getting to know each other, setting team goals,

setting expectations, and providing opportunities to succeed were all encouraged as part of the process. A second visit then occurred at the implementation date to follow up on progress made with previously recommended changes and to reinforce further work on planned process changes.

After implementation, telephone conferences were held every 2 weeks for sites that had begun implementation to provide guidance from the team of experts as needed, and to provide discussion between MTFs that had met success with implementation.

The group practice manager (GPM) whose work began with the team 2-3 weeks before the actual on-site visit was a key factor in managing provider templates. The GPM evaluated historical demand of clinic access, and then projected and forecasted how to build provider appointment templates in order to meet that demand. The clinic's health care delivery team was encouraged to "know" their patient population by accurately assessing and providing access to treatment. Booking guidelines/templates were designed to make it easier to schedule patients with "their" primary care manager (PCM) or PCM team (the team that the patient is specifically enrolled to) rather than cross-book to a different PCM. In that way, increased "continuity" was "built" into the system.

Continuity of care became one of the primary metrics followed across the Air Force. Care coordination conferences, which are inter-disciplinary meetings to discuss the provider's panel of patients, were encouraged on a periodic basis (recommended monthly, but occurred based on team preference). These conferences were intended to tap into the unique skills of each team member to provide the best care possible to patients.

The USAF utilizes registered nurses called health care integrators (HCIs), who are experts at identifying the nature of the population enrolled to that facility and facilitating implementation of clinical practice guidelines and PCMH measures which target the unique needs of that MTF. For example, the HCI might provide demographic information about the patients enrolled to a particular PCM team, revealing more retirees than active duty on that team, leading to an emphasis on chronic care management for that patient population. They might also provide information about the number of tobacco users, or number of women in that population who have not received mammograms, or the number of patients with diabetes who have not received their annual retinal exam. The care coordination conference can then be used to discuss clinical preventive services targeted to specific patients, and the role that each member of the health care delivery team plays in helping the patient to receive those services.

The **third phase** occurred approximately two months after implementation. At that time, a visit by a senior military health care leader was conducted to monitor progress of the team's previously recommended changes, provide further guidance for trouble-shooting problems, and meet with senior MTF leaders to ensure their continued buy-in and leadership support. The next step in implementation was an on-site visit by a General Officer approximately 6 months after implementation to further reinforce the importance of the program, to assist with challenges, and to laud successes. All visits emphasized the importance of the program, encouraging leaders at all levels, from General Officer down to every member of the health care delivery team, to share the mandate to implement the program in accordance with PCMH guidelines and in the allotted time.

Evaluation

The **fourth phase** included an implementation evaluation with a variety of metrics and incentive programs. Measures of success were evaluated by senior Air Force leaders, and included metrics to evaluate continuity, access, satisfaction, ambulatory case mix, Healthcare Effectiveness Data Information Set (HEDIS) measures, and frequency of patients seeking care beyond the MTF and their health care team.

Metrics used.

- Continuity metrics were foundational, and forced a change in appointment booking and appointment protocols. Cross-booking, which is booking appointments with other providers and teams besides the PCM a patient is enrolled to, is now allowed only in exceptional circumstances.
- Access is measured by whether or not each provider has 90 bookable appointments per week that are centrally available to the appointment clerk. Providers are not required to "make up" appointments for leave or Temporary Duty (TDY), as they had been under previous models. This metric was designed to promote better "first-call resolution" and to decrease involvement of other clinic staff.
- Satisfaction will continue to be monitored with the same patient satisfaction survey as used under previous models (the Service Delivery Assessment), but an additional staff satisfaction survey was added to evaluate perceptions of providers, nurses and medical technicians.
- The Ambulatory Case Mix is a measure of success developed to drive the behavior of seeing more complex patients and doing more procedures in the

Family Health Clinic. It involves a combination of weighted scores for patient complexity, diagnosis and billing codes, and is intended as a way to compare pre-/post-PCMH for the same provider.

- HEDIS is a tool developed by National Committee for Quality Assurance (NCQA) and used by more than 90% of America's health care plans to measure performance on important dimensions of care and service (NCQA, 2012). HEDIS consists of a total of 75 measures across 8 domains of care, only some of which are routinely reported in USAF MTFs. HEDIS metrics have been monitored for many years, but a HEDIS composite score was developed as a measure of success for PCMH implementation to see the overall picture of success.
- Lastly, non-PCMH utilization is measured by billing records, with emergency room/urgent care utilization rates and specialty care utilization expected to decrease with continued PCMH success.

Outcomes. Initial evaluation has shown success in many of these measures. Continuity has improved, with overall increases seen at all facilities and patients being able to see the specific provider they are enrolled to as high as 95%. Prior to PCMH implementation, the response rate to the question, "Would you recommend to a friend?" dipped below 50% for the first time. Post-implementation patients were pleased with improved access to care and seemed to embrace continuity with providers more quickly than expected (Kosmatka, 2012). According to anecdotal reports at USAF facilities, provider and technician staff satisfaction has improved. Nurse satisfaction has not had

the same improvement, largely due to a consistent and sometimes inappropriate telehealth burden, and a redistribution of nurse staffing in the PCMH model.

Providers are pleased with the greater control of their schedules and improved continuity, caring primarily for those patients in their empanelment. Initial disease management (DM) efforts are showing improved process/outcome measures with an expectation of further improvement with maturation of PCMH, focused training (DM course in development), and greater access to actionable data through use of computer tools for the health care delivery team. ER/UCC utilization declined from 7 visits/100 enrollees/month in 2011 to 6/100/month in 2012, but more improvement to < 3 visits/100/month is the goal (Kosmatka, 2012). After all sites had the PCMH model in place, emphasis shifted to ensure that all program elements were implemented.

NCQA Recognition

The **final phase** included evaluation and potential recognition by National Committee for Quality Assurance (NCQA) in 2011-2012. Each site completed an assessment of the program elements, and reported on the extent of element implementation (0-100%) for meeting NCQA criteria as a PCMH. TRICARE Management Authority requested 45 clinics (15 each from Army, Navy, and Air Force) apply for NCQA Provider Practice Connections® (PPC)-Patient Centered Medical Home™ (PCMH) recognition. The Air Force selected 15 sites for formal evaluation in fall 2011.

The evaluation process began with a self-scoring readiness assessment by the practice. When ready, the practice completed the NCQA's web-based Survey Tool, responding to questions and attaching supporting documentation to verify responses.

Data sources could include documented processes and procedures, reports, records or files, and materials such as patient education brochures and websites. Once complete, the practice submitted the Survey Tool to NCQA for evaluation. The 2008 NCQA document, *Standard and Guidelines for Physician Practice Connection®-Patient Centered Medical Home™* (PPC®-PCMH™), utilized nine standards for evaluating quality patient care. The standards included important aspects of care, such as access and communication, patient tracking and registry functions, care management, patient self-management support, test tracking, referral tracking, performance reporting and improvement, and advanced electronic communications (NCQA, 2008).

NCQA evaluated all data and documents submitted by the practice against the standards, and awarded the practices with an overall score that can range from 1 to100. To be recognized, a practice site must demonstrate implementation of the nine PPC®-PCMH™ standards and meet a minimum number of "must-pass elements." The practice would have also earned one of three levels of achievement, with level three being the highest, based upon how well they performed the functions required in each element of the standard. This allowed practices with a range of capabilities and sophistication to successfully meet the standards' requirements according to the needs of their patients and their practice's resources. All 15 USAF sites that submitted applications for NCQA PPC®-PCMH™ recognition achieved Level 3 Recognition status, the highest level possible.

Challenges to Overcome

Ongoing challenges include the mobility requirements of military staff, leading to continuous requirements for training new personnel in PCMH principles.

Additionally, maintaining the momentum of change and sustaining the improvements made will require continued efforts from a management standpoint.

Finally, once all sites had successfully implemented the program elements, changes in patient outcomes could validly be attributed to the program by using a pre- and post-assessment of patient outcomes comparing them before and after program implementation. Future research will focus on evaluating patient outcomes for one group of patients, those with type-2 diabetes, before and after program implementation.

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Chapter Three: Manuscript 2

Evaluation of an Innovative Program to Improve Outcomes Among Military Beneficiaries with Diabetes

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Abstract

Patient Centered Medical Home (PCMH) implementation is a practice redesign model that is mandated across all three military services. This article describes the effect of PCMH implementation on patient outcomes and whether NCQA recognition explains variation of *HgA1c*.

Evaluation of an Innovative Program to Improve Outcomes

Among Military Beneficiaries with Diabetes

A previous article by Andrews and Harrington (2013) described the overall process for implementation of the Patient Centered Medical Home (PCMH) at United States Air Force (USAF) medical facilities. It described the phases of the implementation process and associated challenges. The purpose of this article will be to describe a study carried out to determine the effect of PCMH on patients with type-2 diabetes mellitus (T2DM) seen in military clinics, and whether NCQA recognition explains variation of *HgA1c*.

The PCMH was introduced by the American Academy of Pediatrics (AAP) in 1967, initially referring to a central location for archiving a child's medical record (Improving Chronic Illness Care [ICIC], 2011). The AAP expanded the concept in 2002 and it was adopted by the American Academy of Family Physicians in 2002. It was then endorsed by major primary care-governing bodies, and in February 2007, the Joint Principles of the Patient Centered Medical Home were published as part of the Patient Centered Primary Care Collaborative (2007). The Joint Principles of PCMH include a personal physician/provider, a physician-led medical practice, whole person orientation, coordinated/integrated care, an expectation of quality and safe-care, enhanced access to care, and payment reform. This primary care model was designed to improve access, strengthen the relationships between providers and patients, and deliver comprehensive care with coordination among providers (Berenson et al., 2008). Many studies have evaluated PCMH in civilian health care systems, but very few studies have evaluated PCMH in military settings. Most civilian studies have shown that few practices have

implemented all components of the PCMH. No studies were found reporting the extent of implementation among military practices.

PCMH is based upon the Chronic Care Model (CCM) (ICIC, 2012), developed by Edward H. Wagner of the MacColl Institute (Glasgow et al., 2002; Wagner 1998). The CCM identifies elements required for a system-based model to be effective for chronic disease management: patient self-management support, clinical information systems, delivery system redesign, decision support, and health care organization and community resources (ICIC, 2012). A graphic presentation of the model can be seen in Figure 1 (Wagner, 1998).

The CCM illustrates the organization of health care into clinical information systems, decision support, delivery system design, and self-management support, which together interact with Community (resources and policies) leading to productive interactions. This is best facilitated by an informed, activated patient and a prepared, proactive practice team (Wagner, 1998). Permission to use the diagram of the CCM was granted by a representative from the *Annals of Internal Medicine* (see Appendix A).

The CCM combines the organization of health care practices with the resources and policies of the community which yield productive interactions between prepared, proactive practice teams and informed, activated patients. The organization of health care is broad and is the primary area of practice redesign for the USAF. It includes delivery system design, decision support, and clinical information systems.

Delivery system design includes the important elements of appointment access, pre-visit planning (team "huddles"), and missed appointment follow-up. Decision support includes clinical guidelines, preventive services according to clinical guidelines,

abnormal test protocols and alerts, clinician reminders for care, preventive services, risk assessments, and counseling. Clinical information systems include disease registries for chronic disease that are being followed, such as a registry of all patients with diabetes, hypertension, or asthma. Information systems also include process flow sheets, checklists of interventions, patient assessment questionnaires, clinical test tracking, referral tracking, and use of an electronic medical record. All of those aspects of the organization of health care are expected to lead to a prepared, proactive, practice team.

The patient is put in the context of the community, and given resources to aid in self-management support such as patient reminders for care and preventive services, individualized patient education, risk factor screening, self-management materials and programs, and the opportunity for electronic communication between patient and provider. Such support leads to an informed, activated patient, who is then ready to interact with the proactive practice team in productive interactions that result in improved patient outcomes.

Location/Population/Sample

The population for this study included all patients 18-65 years of age seen for T2DM (ICD-9 code 250) and continuously enrolled in TRICARE Prime from March 2008 through May 2011 in Family Health Clinics (Medical Expense Personal Reporting System code BGXX) at 1 of 15 military facilities that applied for National Committee for Quality Assurance (NCQA) Provider Practice Connections® (PPC)-Patient Centered Medical Home™ (PCMH) recognition in Fall 2011. These 15 sites were chosen because they had early and robust PCMH implementation in the USAF. The population included all adult active or retired military personnel, including their dependents, with T2DM

using those clinics. Patients with type 1 diabetes or gestational diabetes were excluded. The population of patients with T2DM varies across facilities. Two of the 15 facilities had less than 20 patients meeting all criteria, so only 13 facilities were used in this study.

Active duty military staff at military facilities can be very mobile due to the readiness mission of the military, plus requirements to move to new assignment locations that typically occur every 3-4 years. However, the population of patients for this study was primarily retirees and their dependents, so it was expected to be much more stable. One aspect of the study was to evaluate the effect of PCMH implementation on the population of patients enrolled continuously to each site, which would allow for a more accurate measure of the effect of PCMH implementation.

Data were obtained retrospectively from the USAF electronic medical record (EMR), called the Armed Forces Health Longitudinal Technology Application (AHLTA), using data requested from the Air Force Medical Service Agency (see Appendix B). AHLTA is an enterprise-wide EMR utilized in all fixed and deployed U.S. facilities worldwide. Patient-level data were obtained by clinics without names or other identifying data. G*Power analysis (Faul, Erdfelder, Buchner, & Lang, 2009), conducted utilizing an alpha of 0.05 and a power of .95 (*F* tests for ANOVA) with two groups (pre- and post-PCMH implementation) and three measurements (*HgA1c*, *ED visits*, and *hospitalized days*), indicated that a sample size of 142 was appropriate for each outcome. Three outcomes were measured, requiring a sample size of 426 subjects. Total sample size for this study started with 2,046 subjects but ended with 1,556 that had remained continuously enrolled during the entire study period.

Institutional Review Board (IRB) approval as an exempt study was obtained from the University of Texas at Tyler (see Appendix C). USAF IRB was not required since this was an exempt study as designated by the Wilford Hall Ambulatory Surgery Center Clinical Research Division. However, since the study used medical information from Department of Defense beneficiaries, review and approval were obtained from the Air Force Surgeon General's Human and Animal Research Panel (see Appendix D).

Research Hypotheses

Hypothesis 1. There is a difference in outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) for T2DM patients exposed to pre- and post-implementation of PCMH in military clinics.

Hypothesis 2. There are differences in the outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) of T2DM patient groups across 15 USAF clinic facilities.

Hypothesis 3. Variation in recognition scores on the nine NCQA PPC®-PCMH™ standards explain variation in outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) among patients with T2DM seen in military clinics.

A summary of hypotheses, variables, data source, and statistical tests is in Table 2. NCQA PCMH recognition scores were obtained from the TRICARE Management Authority (TMA) (R. Julian, personal communication, December 2, 2011).

Design/Methods/Measures

This study was a retrospective, pre/post design used to evaluate: 1) the impact of PCMH implementation on patient outcomes, 2) the impact of PCMH implementation between facilities, and 3) the effect of NCQA PCMH recognition elements on patient outcomes on patients with T2DM enrolled to Air Force facilities. Exploratory data

analysis was done to evaluate parametric assumptions using methods recommended by Field (2009) and Mertler and Vannatta (2005) including evaluation of the skew, kurtosis, and histogram with a normal curve overlay. The *HgA1c* variable was normally distributed on a histogram but had a skew of 2 and a kurtosis of 5.5. Despite the skew and kurtosis, the decision was made to use the paired *t-test* on the *HgA1c* variable because the *t-test* is robust and enables results to be evaluated using individual patients' paired results from 2008 and 2011. The *HgA1c* variable was transformed to meet the assumption of normality to facilitate the use of the variable in multiple regression. Neither *hospitalized days* nor *emergency department (ED) visits* variables met the assumption of normality, and thus were analyzed using non-parametric statistics in H1 and H2 and were omitted from regression analysis for H3. A flow chart of the study design is in Table 3.

Demographic and outcome data on patients with diabetes involved analyses of secondary data centrally pulled from AHLTA and linked to each facility. Patients with T2DM frequently have co-morbidities, so adjusted clinical groups (ACGs) were used to control the rival hypothesis of differing illness burden from one facility to another. The ability of ACGs to describe the burden of illness in populations has been validated in several studies (Carlsson, Borjesson, & Edgren, 2002; Carlsson, Strender, Fridh, & Nilsson, 2006). Additionally, Ash and McCall (2005) validated the use of ACGs for risk-adjustment in the military health system. Their study on continuously-enrolled TRICARE Prime enrollees (n = 2.3 million) compared ACGs to three other risk adjustment models and found that all four were far better for risk adjustment than age-sex models. As such, ACGs can be used to compare morbidity, monitor performance at

facilities, and help identify high-risk cases for disease management by applying "predictive modeling" at the individual level (Ash & McCall, 2005, p. ES-3).

ACGs are a method of categorizing patients into categories of morbidity and resource consumption over the course of a given year (Johns Hopkins Bloomberg School of Public Health, 2012). The ACG methodology uses a branching algorithm to place people into one of 102 discrete categories based on their assigned ADG, their age, and their sex. Patients are assigned a single ACG based on diagnoses assigned by all clinicians seeing them during all contacts, regardless of setting. Within each ACG, patients are assigned to a Resource Utilization Band (RUB). The RUB is a measure of morbidity burden measured on a range of 0-5 where a score of 0 indicates no illness or morbidity and a score of 5 indicates severe illness burden or maximum level of illness. The RUB is a range of 0-5, where 0 = *no or invalid diagnosis*, 1 = *healthy users*, 2 = *low*, 3 = *moderate*, 4 = *high*, and 5 = *very high*. A mean RUB for each facility was obtained and used to compare *between group* effects.

The study population had few (.8%) active duty (AD) members, as expected. A small percentage (2.1%) of patients with T2DM were AD Family Members (ADFMLY), but the majority of subjects were in the beneficiary category of either retired (RT) (55.1%) or family members of retirees (RTFMLY) (42.0%) (see Table 4).

Originally, the study intended to examine results from 15 military sites, but 2 were excluded because small sample sizes of patients with type-2 diabetes mellitus threatened patient confidentiality. Patients meeting all criteria decreased the sample size to 2,046 subjects. The number of patients remaining enrolled to the same military clinic in 2011 and meeting all study criteria decreased to 1,556 in 2011, with considerable

variation in sample sizes per clinic ranging from 19 in site 120 to 306 in site 14. The resulting study sample size of 1556 was adequate to detect a small effect when analysis was done including all sites. The samples within military sites in 2008 varied from 26 to 430. Overall, 1,556 patients with T2DM were seen in the 13 sites with a mean age of 54. Small sample sizes at some sites undermined the ability to detect improvements when results were evaluated for individual sites, so Cohen's *d* was used as an additional measure of comparison to determine magnitude of effect. Table 5 presents the demographic information overall and by military site. Overall, patients ranged in age from 26 to 63 with a M_{age} of 54 (*SD* 5.9). The sample was primarily Caucasian (65%), with 16.4% Blacks, 13.6% Asians, and 13.6% other race. Data regarding Hispanic and other ethnicities were not available and therefore were not examined.

Results

Hypothesis 1. There is a difference in outcomes (*HgA1c*, *hospitalized days*, and *ED visits*) for patients with T2DM exposed to pre- and post-implementation of PCMH in military clinics.

Table 6 shows the 13 military sites (numbers assigned to maintain confidentiality), mean age of the patients with T2DM, mean *HgA1* scores in 2008 and 2011, the number of patients with T2DM who were hospitalized by site with the mean number of hospitalized days in 2008 and 2011, and the number of patients with T2DM who visited the *ED* with the mean number of visits in 2008 and 2011. H1 was evaluated by *t-tests* to study results "within subjects," comparing patient-level data pre- and post-PMCH implementation. Overall, there was improvement in *HgA1c* from 2008 to 2011,

but an increase in the number of *hospitalized days* and *ED visits*, and that increase did not reach significance.

T-test results for *HgA1c* revealed that only three facilities showed statistical significance in their improvement of *HgA1c* (see Table 7). Of those three facilities, two showed a decrease in HgA1c ($p = 0.000$, $p = 0.002$), and the third showed an increase ($p = 0.04$). The hypothesis implied that the change would have been positive, reflected in a decreased HgA1c, but results show mixed support for the hypothesis that PCMH produces a change in outcomes for T2DM patients. Of the remaining clinics that did not show statistical significance in *HgA1c* values, three showed worse *HgA1c* values in 2011 compared to 2008, one showed the same, and six saw improvements in *HgA1c* values, but the results were not significant. Relatively small sample sizes at many sites may have undermined the power needed to detect the effect, and therefore may have contributed to this lack of statistical significance.

Hospitalized bed days and *ED visits* were compared in Table 8. Overall, 6.7% of patients were hospitalized in 2011 with a mean number of 6.79 days which was higher than the mean of 4.39 in 2008. It is noted that 22% visited the *ED* in 2011, with an increase from a mean of 1.33 *ED visits* in 2008 to 1.44 visits in 2011. Non-parametric testing using a Wilcoxon Signed Ranks Test was done to compare both *hospitalized days* and *ED visits*. There was no significant difference in *hospitalized bed days* across all 13 military sites, and only one site had a significant difference in *ED visits* ($z = -2.1$, $p = .04$) with an increase in visits from 2008 to 2011 (see Table 8). Hypothesis 1 was rejected overall.

Hypothesis 2. There are differences in the outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) of T2DM patient groups across 13 USAF clinic facilities.

The second hypothesis measured the effect of PCMH implementation among different facilities. ANOVA was used to compare the effect of PCMH implementation across all 13 military treatment facilities for *HgA1c*, and the non-parametric Kruskal-Wallis *H* test was used for *ED visits* and *hospitalized days* because there was so much variability in *Standard Deviation* values (*SD*) (see Figure 2). The sites were not significantly different in *HgA1c* values in 2008, but they were significantly different in 2011 ($p = .024$ and $p = .023$, respectively). There was a significant effect of PCMH implementation on *HgA1c*, $F(11, 1543) = 1.97$, $p = .024$ and as noted previously in Table 7, the mean *HgA1c* decreased from a *M* of 7.12 in 2008 to a *M* of 6.98 in 2011 ($p = .000$). There was no significant improvement in *ED visits* from 2008: $H(12) = 16.0$, $p > .04$, to 2011, $H(12) = 14.83$, $p > .05$. There was no significant reduction in *hospitalized days* from 2008, $H(11) = 16.91$, $p > .05$, to 2011, $H(11) = 12.24$, $p > .05$.

In order to assess the magnitude of effect across MTFs from pre-post implementation, effect sizes were calculated for the study variables using Cohen's *d* (Cohen, 1992). Table 9 shows number of patients per site in 2008 and 2011, Mean age, Mean *HgA1c*, and *SD* for 2008 and 2011, *p* value, and Cohen's *d*. Effect size, which is a measure of how many standard deviations' difference there is between the means of the treatment and comparison groups, is a better indicator than statistical significance on whether an effect is meaningful in a practical sense (Texas Education Agency Best Practices Clearinghouse [TEABPC], 2013). In other words, the effect size shows how effective a measure really was. In this case, effect sizes were small, ranging from 0.03 to

0.29, with the exception of site 95. That site showed a large effect size of 0.72, with a worsening of *HgA1c* that was statistically significant ($p = .04$). Significance was also reached at sites 14 and 73 ($p = .00$ and $p = .002$, respectively), although it was a small effect size of 0.29 at each site.

Many patients had zero *hospitalized days* or did not visit the *ED* at all. The large number of zero values made the data very homogenous. Cohen's *d* was calculated for effect size for *hospitalized days* (see Table 10) and *ED visits* (see Table 11). A large effect size was noted for site 46 (Cohen's $d = 0.97$), indicating a noteworthy change in practice. Mean *hospitalized days* at that site decreased from 6.43 in 2008 to 2.82 in 2011, but *t-tests* did not reach significance. This may have been due to the large amount of variability in standard deviations and the small sample size at that site. Similarly, site 119 showed a large effect size of 0.80; although, this reflected an increase in *hospitalized days* from 6.8 in 2008 to 28.00 in 2011. The largest effect size for *ED visits* was 0.63 at site 120, which reflected an increase in *ED visits*. Sites 101 and 119 had similar effect sizes (0.60 and 0.59, respectively), with both sites showing a decrease in Mean *ED visits*. Thus, hypothesis 2 was supported for *HgA1c* but not for *ED visits* or *hospitalized days*.

Hypothesis 3. Variation in recognition scores on the nine National Committee of Quality Assurance (NCQA) Provider Practice Connections® (PPC)-PCMH™ standards explains variation in outcomes (*HgA1c*, *ED visits*, & *hospitalized days*) among T2DM patients in military clinics.

Multiple regression was used to evaluate this hypothesis. None of the variables, however, were normally distributed and thus did not meet parametric assumptions. The *HgA1c* variable was transformed to meet the assumption of normality to facilitate the use

of the variable in multiple regression. Neither *hospitalized days* nor *ED visits* variables met the assumption of normality, and thus were analyzed using non-parametric statistics in H1 and H2, and were omitted from regression analysis for H3. All sites achieved a high baseline, with little variation evident. This hypothesis would have had more power if NCQA scored results using multiple reviewers, but lack of variance in scoring undermined ability to use the scores well. A degree of bias exists for several reasons. First, each site submits their data rather than an unbiased "inspector" collecting it. Secondly, NCQA assigned a single score, rather than several ratings from different staff members, thus removing the opportunity for inter-rater reliability. Even with transformation, variables did not meet the assumption of normality, contributing to multicollinearity. Limited variability across sites and no variability within sites (due to single NCQA score) resulted in means that lacked variability and were not normally distributed. Additionally, some scores were dichotomous. Therefore, it is impossible to inform individual sites what elements explain their outcomes, which was originally planned, because the sites have a single score.

The standards did not yield a significant model that explained variation in *HgA1c*. Figure 3 suggests that patient tracking (PPC2) explains 0.3% of the variation in *HgA1c*, care management (PPC3) explains 0.7%, and performance reporting and improvement (PPC8) explain 0.3%. The other standards do not make a significant contribution. Rerunning the MR with just those three standards resulted in a model that explained 0.09% of the variation in *HgA1c*, so it is a very weak model (see Figure 3). Additional work could be done to evaluate the variables further.

While not part of the original proposal, some additional rival hypotheses were tested, including data involving referrals, kept appointments, and NCQA PCMH scores (see Table 12) and differences in ACG RUB (see Table 13). Only 3 of 13 sites showed improvement in ACG RUB, and one site did not change. It is apparent that the NCQA scores have serious validity issues since there is minimal variation in NCQA scores and wide variation in kept appointments. The expectation would be that NCQA scores would correlate with the percent of kept appointments, but data did not support that expectation (see Table 14).

Education level was collected as part of the original proposal, but was rarely included in the EMR, thus it was not analyzed. Additional data were obtained that might explain differences or lack thereof regarding patient outcomes evaluated in this study. Additional data collected included BMI, date of T2DM diagnosis (to determine length of time as a patient with diabetes), race, and eye exams. BMI data were collected and evaluated for 2008 and 2011, but a paired samples *t-test* found no significant difference at the patient level pre- and post-PCMH implementation, and ANOVA did not find significant differences among MTFs.

Race data was missing in 38.8% of the sample population, but the remaining 59.0% showed significant differences in *HgA1c* in 2008 and 2011 by race (see Table 15). There was significant improvement from 2008 to 2011 in Whites, Asians, Blacks and those with Other races. In 2008, $F = 3.63$, $df = 4/852$, $p = .006$; in 2011, $F = 2.73$, $df = 4/943$, $p = .028$. There were no significant differences in *hospitalized days* or *ED visits* by race (see Table 16). Males fared worse with diabetes than women and there was a significant difference in *HbA1c* by gender in 2008 $t = -3.77$, $df = 1469$, $p = .00$; *HgA1c* by

gender in 2011 t = -3.15, df = 1550, p = .002. There was a significant difference in *ED visits* in 2011 by gender, but otherwise no gender differences in *hospitalized days* or *ED visits* in 2008 (see Table 17). Date of T2DM diagnosis was frequently entered into EMR, as were dates for eye exams during the two reporting periods, but analysis of that data is outside the scope of this study. However, it is possible to obtain that data for use in future research to investigate a myriad of related potential topics.

Discussion

Hypothesis 1. The first hypothesis measured the effect of PCMH implementation on individual patient outcomes of *HgA1c*, *hospitalized days*, and *ED visits*. The greatest effect of PCMH implementation in this study was on *HgA1c*. Overall, mean *HgA1c* improved across sites. Specifically, eight sites showed improved *HgA1c*, four showed worse *HgA1c*, and one site remained the same. Qaseem et al. (2007) documented that desirable control of *HgA1c* is at a level of 7% or less, which is in line with results of this study.

Patients at study facilities showed a mean *HgA1c* of 7.16 in 2008 and 7.01 in 2011, respectively. These desirable results reflect a high level of quality of care that is occurring at military facilities and is reinforced by PCMH. The greatest statistical significance in *HgA1c* was seen in facilities that had the largest sample size. This is not surprising, since statistical significance is dependent on sample size (Texas Education Agency, 2013). It is notable that the majority of facilities (8 out of 13) showed improvement in mean *HgA1c*, even though not all showed statistical significance. The PCMH features of continuity with the PCM team, and the feature of the health care team and patient getting to know each other, help develop a level of trust that encourages

patient engagement and involvement in their health care. This may be the distinctive factor that has influenced improvement in *HgA1c*. Additionally, PCMH encourages a more proactive approach to patient care, such as contacting the patient and scheduling visits more often with providers when the *HgA1c* is less desirable.

Mean *hospitalized days* and *ED visits* increased overall and in the majority of MTFs. Only one MTF showed a decrease in *hospitalized days*. Mean ED visits also increased overall and in the majority of MTFs, with only four MTFs showing a decrease. This result may partly be a reflection of the majority of USAF MTFs being outpatient clinics, so *hospitalized days* and *ED visits* would occur outside of the realm of the PCM team. If the MTF was an inpatient facility, it is possible the PCM would round on their own patients, thus further reinforcing the concept of "ownership" of patients and maintaining continuity of care. Such an option is not possible for MTFs that offer outpatient care only, with *hospitalizations* and *ED visits* only accessible at separate facilities.

In a study from a civilian community, Reid et al. (2009) reported that PCMH patients utilized 29% fewer *emergency department (ED) visits* than a control group. Inpatient admissions did not differ significantly between PCMH patients and controls, but PCMH patients had 11% fewer hospitalizations for ambulatory care sensitive conditions. In a follow-up study, Reid et al. (2010) showed that positive results continued, as patients in a PCMH experienced 29% fewer *ED* visits and 6% fewer *hospitalizations compared to those not in a PCMH*, with a total savings of $10.30 per patient per month after 21 months. In military facilities with PCMH, Kosmatka (2012) reported that ER/UCC utilization declined from 7 visits/100 enrollees/month in 2011 to 6/100/month in 2012.

Hypothesis 2. The second hypothesis measured differences in outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) of T2DM patient groups across 13 USAF clinic facilities. Results showed there was a significant effect of PCMH implementation on *HgA1c*, $F(11, 1543) = 1.97$, $p < .05$ and as noted previously in Table 7, the mean *HgA1c* went down from an *M* of 7.12 in 2008 to an *M* of 6.98 in 2011 ($p = .00$). There was no significant improvement in *ED visits* from 2008: $H(12) = 16.0$, $p > .04$, to 2011, $H(12) = 14.83$, $p > .05$. There was no significant reduction in *hospitalized days* from 2008, $H(11) = 16.91$, $p > .05$, to 2011, $H(11) = 12.24$, $p > .05$.

In fact, overall, *hospitalized days* and *ED visits* increased. Several MTFs in this study had a small sample size. Statistical significance is heavily dependent upon sample size, so effect size is a way to determine if an effect is meaningful in a practical sense for small study samples (TEABPC, 2013). Some MTFs had a large effect size: site 46 with effect size of 0.97 for decreased *hospitalized days* and site 119 with effect size of 0.80 for increased *hospitalized days*. One site performed notably well, while the other showed a notable decline in performance.

While all MTFs utilize the same PCMH standards and guidelines, there are many potential influences to how well those standards are performed. Leadership style at each facility, continuity or lack of staff, and information technology capabilities are all potential influences on the delivery of health care at each site. These findings need further investigation into policies and processes in place at each MTF that might have influenced the differences.

Site 119 showed a notable decline in performance related to *hospitalized days*, and numerous possibilities could exist to explain such differences. Support staff, such as

disease managers, case managers, or medical technicians, are vital to PCMH processes, such as reinforcing patient engagement at every encounter with MTF staff, and a sudden decrease or increase in support staff could influence patient outcomes in a negative or positive way. Some facilities had developed robust disease management programs as part of earlier USAF initiatives such as Clinical Practice Optimization. Improvements in patient outcomes were noteworthy under those programs in some facilities, and it may have been difficult to continue improvements, leaving maintenance or decline as the only available option.

Conversely, *ED visits* also reflected notable changes, some positive and some negative. *ED visits* declined at site 101 with effect size of 0.60 and site 119 with effect size of 0.59, but increased at site 10 with effect size of 0.59 and site 120 with effect size of 0.63. Site 119 showed an increase in *hospitalized days,* with a large effect size of 0.80, but a decrease in *ED visits,* with a moderate effect size of 0.59. This mixture of positive and negative results is accompanied by a decrease in Resource Utilization Band (RUB), from 3.36 in 2008 to 3.26 in 2011. Such a combination of results supports positive efforts in PCMH and specifically in disease management of patients with T2DM. Staff continuity, such as having civilian disease managers instead of those that are active duty military nurses, may contribute to more positive results. This study showed an overall increase in *ED visits*, but that result is not consistent with other studies.

One of the few articles that described PCMH in military facilities reported improvement at a Naval facility. Marshall et al. (2011) reported that PCMH at National Naval Medical Center decreased network *ED visits* per 100 patients from 7.7 to 6.1, and total annual *ED visits* per 100 patients from 70.1 to 42.4, when comparing pre-PCMH in

2007 to post-PCMH in 2009. Those results were from a military facility, but were from a Navy inpatient MTF rather than an Air Force MTF.

Kosmatka (2011) reported specifically on ED and Urgent Care utilization per 100 patients in USAF facilities, comparing PCMH facilities to non-PCMH facilities from Feb-Jul 2011, and the number declined. The results from the current study are reported based on mean *ED visits* and mean *hospitalized days*, reflecting a slightly different measurement than reported by Kosmatka (2011) and Marshall et al. (2011), who measured their results per 100 PCMH patients.

According to the Centers for Disease Control and Prevention (CDC) (2013b), the average length of stay in non-Federal short-stay hospitals across the U.S. is 4.9 days, whereas the average length of stay for patients with diabetes as first-listed diagnosis in 2009 was 5.0. Results of this study are close to those reported by CDC, with mean *hospitalized days* going from 4.39 in 2008 to 6.79 in 2011. *ED visit* rates for diabetes as any listed diagnosis among adults were 56 *ED visits* per 100 diabetic adults in 2009 (CDC, 2013a). Results of this study show that mean *ED visits* went from 1.33 in 2008 to 1.44 in 2011 for the 342 patients that went to the ED. Results of this study may be influenced by the fact that age of the sample population (18-65) may not be high enough to capture an older population when hospitalizations from diabetic complications are more likely to occur.

Hypothesis 3. The third hypothesis evaluated whether variation in recognition scores on the nine NCQA PPC®-PCMH™ standards explained variation in the patient outcomes of *HgA1c, ED visits, & hospitalized days. ED visits* and *hospitalized days* did not meet the assumption of normality and were omitted from regression analysis for this

hypothesis. NCQA PPC recognition scores had limited variation, so they were not useful in explaining variation on *HgA1c* values at each MTF. The method of NCQA scoring, where applications are reviewed and a single score is assigned does not lend itself to providing enough variation to accurately assess and evaluate this hypothesis. Additionally, it is up to each MTF to select the appropriate patient records and data required for recognition application, so several were allowed to resubmit information to meet application requirements, which improved their score and decreased variation.

Limitations

The use of retrospective secondary data posed some challenges to this study. Some types of data requested were not readily available in the EMR, such as education level and ethnicity. Such variables might have helped explain results or provided additional insight into relationships of various pieces of data.

The sample size originally started out at 4,933 but diminished to 2,047, when only those patients that were enrolled to each site for the entire study period were accounted for. Additionally, two sites were eliminated when the sample size of patients with T2DM was below 20, thus threatening patient confidentiality. Sites with small sample sizes undermined the ability to detect improvements when results were evaluated for individual sites.

Sample size at various sites varied greatly (from 19 to306). Such a widely disparate number of cases made it difficult to compare site groups. Some sites had no patients that had been hospitalized or had visited the ED during the study period. Small sample sizes at various sites impacted results, as did a large amount of variation between standard deviations. Still, sites with the largest populations were able to show

statistically significant improvement in *HbA1c*, which are obviously performing in an outstanding fashion in delivery of health care. Perhaps this is due to multiple sub-specialty services in existence at their site, the availability of personnel to cover for staff that is absent, and better continuity of civilian staff that migrate to large facilities. It is also possible that elements of PCMH are more woven into the system of health care and less dependent on a few high-functioning individuals to perform. Sites for this study were chosen based on early and robust implementation of PCMH, but future studies may need to focus on sites that are especially popular with retirees and their dependents in order to obtain sample sizes more amenable to statistical analysis.

The findings validate how difficult it is to change *HgA1c*, given military sites already were delivering high quality care. The low numbers of *hospitalized days* and *ED visits* further validate outstanding care management that enables military beneficiaries to avoid those stressful and costly outcomes. Comparing patient outcomes between sites, there was a significant effect of PCMH implementation on *HgA1c*. No significant improvement was noted in *ER visits* or *hospital days*. NCQA PPC®-PCMH™ standards did not explain variation in *HgA1c*.

A further limitation related to the comparison noted between NCQA scores, referral appointments, and percentage of kept appointments. That comparison revealed serious validity issues in NCQA scores. NCQA scores had little variation, and they did not seem to correlate with the percentage of kept appointments. Site 10, for example, had a very low percentage of kept appointments (.09%), but had an NCQA total score of 95.5. Given the percentage of kept appointments, the expectation would be that the scores should be more reflective. The results reflected in Table 12 do not seem to correlate well,

and may reflect inconsistent or inaccurate record keeping. Since PCMH implementation included many redesign components, it is impossible to determine which intervention components most influenced results.

Strengths

Strengths of this analysis show that it was planned and tested for effectiveness in a real-world setting, and it was intended to be used to further improve health care delivery for the AFMS. The availability of data in the EMR led to the strength of accuracy of diabetic coding that facilitated correct inclusion of all individuals with T2DM.

Another significant strength was the access to comprehensive data regarding a wide range of outcomes for military beneficiaries from every MTF in the AFMS. A related strength was the availability of a skilled data analyst that helped the PI to specifically define study and population parameters. That data analyst, skilled in medical records management conducted all data queries to insure accurate and complete capture of all available data.

It was also a study strength to include multiple sites. Comparison across 13 sites provided a comprehensive look at PCMH implementation from an Air Force-wide perspective, thus informing AFMS leaders about future directions for PCMH maintenance and potential areas to focus efforts. The 13 sites were of varying sizes (population 26-430) and locations (the Northeast, Southeast, mid-South, Southwest, West coast, Northwest, and Alaska). Some sites would likely have a large retirement population, others less so, which again would strengthen the evaluation of the PCMH program rather than evaluate influences determined by local culture or variation. It was

also a strength to maintain site anonymity with the exclusion of two sites where small diabetic patient populations might lead to identification of the clinic sites.

A final strength was that this study evaluated PCMH implementation at the beginning of the program, but again several years post-implementation. By then, it is possible that active duty military health care staff that started the program at a particular MTF would have moved as part of the permanent change of station (PCS) move cycle that normally happens every 3-4 years. Therefore, this study was able to truly evaluate PCMH, rather than gauge the effectiveness of dynamic individual personnel who are able to start a project but when they leave the project declines.

Recommendations

Several recommendations can be made as a result of this study. First, it was difficult to evaluate referral data related to care of patients with T2DM, so improved documentation or more direct retrieval of referral data would help in future studies. In this case, comparison of number of referral and percent of kept appointments to NCQA scores would have been of interest. A recommendation for NCQA would be to add more items to improve the range of self-management support and referral tracking scoring to foster insight into the issues that are reflected in the kept appointment issues. There was a wide range of percentage of *kept appointments* between different sites that invites further investigation to determine causality.

Additional work could be done to encourage standard recording and coding methodology in the EMR, so that future data collection on similar topics would yield more useful data. For example, more complete information about referrals and kept referral appointments might be useful to make more accurate assessments and

correlations between NCQA scores, ACG RUBs, and *kept referral appointments*. Additional demographic variables, such as education, race, and ethnicity, might also further inform future studies of PCMH effectiveness if they are more consistently documented in the EMR. Other data, such as date of T2DM diagnosis, cholesterol level, and eye exam, might be more suited for a future study to evaluate compliance to clinical practice guidelines for diabetes management, rather than this study's intent of evaluating PCMH implementation.

This study also evaluated NCQA PPC®-PCMH™ recognition, but lack of variation in NCQA scores (whether between MTFs or from multiple NCQA evaluators) limited insight. The use of multiple trained, on-site evaluators to score NCQA PCMH application documents is essential to unbiased site assessments. Having more than one NCQA evaluator would establish inter-rater reliability and strengthen the regression portion of the study, by providing assessments that would more accurately reflect performance and generate more score variation. Such variation would make it more possible to inform sites about areas where their performance is excellent and areas where improvement is needed.

This study evaluated a population limited to 18-65-year-olds in order to consistently capture patient data for patients enrolled to Tricare Prime. Patients over the age of 65 may have many more diabetes-related health encounters, but their health care is not consistently provided at military facilities. A recommendation for future research would be to investigate PCMH outcomes in military facilities specifically for patients over 65.

The military should continue to use the PCMH model. It reflects elements of the CCM, and promotes a patient-centric health care system that encourages involvement between patients and all members of their health care team across the MTF. It encourages every member of the health care team to be involved in health care delivery within their scope of practice, and that each member has a vital role to play. It encourages MTF support through information technology resources, as well as patient engagement and involvement, so that care is self-motivated, rather than only "provided." Customer satisfaction continues to be high with PCMH, but PCMH also evaluated staff satisfaction. Staff satisfaction results from "ownership" of their schedules and the continuity provided in consistently seeing "their" patients—the ones that are specifically enrolled to that PCM team.

This study was conducted at a mixture of inpatient and outpatient MTFs. While every MTF has outpatient capability, it would be interesting to investigate whether or not having inpatient and ED capability co-located at the same site as outpatient clinics would influence the number of *hospitalized days* or *ED visits*.

The USAF is migrating to use of MiCare, which is a secure messaging system that allows for electronic communication between the patient and their health care team. Future research could investigate whether or not the convenience of secure messaging, such as email via the MiCare system, impacts patient outcomes.

Conclusions

The USAF sites already had skilled professionals working diligently to deliver high quality care and continuously improve processes to result in good patient outcomes such as controlled *HgA1c* values, limited hospitalizations, and limited *ED visits*. Given

the environment of high quality care already in existence in these facilities, even major practice redesign cannot make a major difference in good outcomes that already exist. The new care paradigm of PCMH had little opportunity to improve already consistent results in health care provided by quality health care professionals. Patients with T2DM are a challenging population, and even a superior care delivery method may have little chance to improve the outcomes.

The outcomes of this study were not what was expected, but may simply reflect a system that already delivers high quality health care to patients with T2DM. Additional investigation and evaluation on patient safety measures and encouragement for process improvement efforts should be ongoing initiatives at all health care facilities, whether military or not.

The USAF has invested significantly to accomplish practice redesign as part of PCMH implementation. However, the USAF continues to emphasize quality care delivery, so this study may just reflect care that is already of high quality, and is therefore hard to improve further. While some facilities did show significant improvement in patient outcomes, this study may not have captured care that was already good overall.

In conclusion, support was found for the effect of PCMH implementation on *HgA1c* of patients seen in military clinics for T2DM. Support for PCMH having a positive effect on *hospitalized days* and *ED visits* was mixed. Evidence was not found for the ability of NCQA scores to explain variation in *HgA1c*. Future research is called for to determine if PCMH implementation produces positive effects in other measures such as overall *ED visits* or *hospitalized days* (not associated with diabetes) or with other chronic diseases.

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Table 2

Hypotheses, Variables, Data Source, and Statistical Tests Used

Hypothesis	Variable	Data Source	Statistical Test
H1: Impact of PCMH implementation on patient outcomes	*HgA1c*	EMR	*T-test*
	# ED visits	EMR	
	# hospitalizations	EMR	
H2: Effect of PCMH implementation among different facilities	*HgA1c delta*	EMR	ANOVA
	# ED visits delta	EMR	
	# hospitalizations delta	EMR	
H3: Variation in PCMH recognition scores on patient outcomes	*HgA1c*	EMR	Multiple regression
	Access and communication	TMA report	
	Patient tracking and registry	TMA report	
	Care management	TMA report	
	Patient/self-management	TMA report	
	Electronic prescribing	TMA report	
	Test tracking	TMA report	
	Referral tracking	TMA report	
	Performance reporting	TMA report	
	Electronic communications	TMA report	

Table 3

Flowchart of Study

Collection Period–PRE	Data Collected	Collection Period–POST	Data Collected
Pre-PCMH: *n* = 13 MTFs Mar 2008-Aug 2008	Age, gender, race, education level, last *HgA1c*, *ED visits*, *hospital days*, ACG RUB	Post-PCMH: *n* = 13 MTFs Jun 2011-Nov 2011	Last *HgA1c*, *ED visits*, *hospital days*, education level, ACG RUB
		Post-PCMH: *n* = 13 MTFs Jun 2011-Nov 2011	NCQA PPC-PCMH Recognition level, overall score, standard score, element score

Table 4

Beneficiary Categories of Study Population

	AD	ADFMLY	RT	RTFMLY
% study population	.8	2.1	55.1	42.0

Table 5

Military Site Demographics

Site	F	%	Age *M*	Age *SD*	Age Range	Gender % Male	Race % White	Race % Black	Race % Asian	Race % Other
14	430	21.0	55	5.5	33-62	51.6	40.9	12.4	11.8	34.9
95	366	17.9	54	5.9	34-63	59.8	76.9	14.2	3.2	5.3
73	215	10.5	54	5.8	35-62	54.0	59.8	29	4.7	6.5
6	210	10.3	52	6.5	29-62	50.5	77.2	8.2	3.7	11.0
46	193	9.4	54	5.5	37-62	57.5	68.1	23.4	2.1	6.4
9	128	6.3	53	5.5	36-61	67.2	62.5	20.0	2.5	15.0
101	118	5.8	53	5.8	31-61	49.2	67.9	22.6	3.6	6.0
119	118	5.8	53	6.5	26-61	55.9	91.3	4.3	0.0	4.3
10	88	4.3	54	5.6	37-61	54.5	60.9	13.0	0.0	13.0
19	63	3.1	53	5.4	37-62	58.7	33.3	33.3	0.0	33.3
114	63	3.1	56	4.7	38-61	42.9	81.0	4.8	0.0	14.3
129	28	1.4	54	6.1	42-61	46.4	66.7	0.0	0.0	33.3
120	26	1.3	50	6.4	37-62	57.7	56.3	25.0	0.0	18.8
Total	2046	100.0	54	5.9	26-63	54.9	65	16.4	13.6	13.6

Table 6

HgA1c, Bed Days, and ED Visits

		Alc			*Hospitalized bed days*			*ED visits*		
Site	Age *M*	Patients 2011	*M Alc* 2008	*M Alc* 2011	Patients 2011	*M Bed* days 2008	*M Bed* days 2011	Patients 2011	*M ED* visits 2008	*M ED* visits 2011
14	55	306	7.64	7.22	25	4.64	7.96	82	1.27	1.57
95	54	301	6.87	7.00	26	2.27	6.62	75	1.48	1.47
73	54	179	7.19	6.86	13	2.13	3.46	43	1.22	1.35
6	52	142	7.07	6.90	7	3.89	3.14	43	1.35	1.70
46	54	157	6.80	6.84	11	6.43	2.82	25	1.19	1.32
9	53	92	7.27	7.06	6	4.83	5.17	20	1.31	1.35
101	53	97	6.88	6.85	6	9.78	11.33	12	1.45	1.08
119	53	99	7.02	7.07	2	6.80	28.00	10	1.40	1.00
10	54	68	7.21	6.92	0	0.0	0.0	6	1.00	1.17
19	53	45	7.40	7.22	2	3.33	6.50	56	1.00	1.14
114	56	47	7.15	7.36	4	4.00	18.25	56	1.63	1.29
129	54	24	6.61	6.75	2	3.50	1.00	7	1.00	1.14
120	50	19	6.85	6.75	1	0.0	1.00	5	1.00	1.20
Total all sites	54	1556	7.16	7.01	105	4.39	6.79	342	1.33	1.44

Table 7

HgA1c Only

Military Sites	F	%	Paired *t-test* *HgA1c* t	*df*	*p*	*HgA1c* 2008	*HgA1c* 2011
14	430	21.0	4.95	239	.000	7.61	7.21
95	366	17.9	-2.07	222	.04	6.87	7.04
73	215	10.5	3.16	110	.002	7.27	6.79
6	210	10.3	1.066	118	.29	6.97	6.85
46	193	9.4	0.99	125	.33	6.84	6.72
9	128	6.3	0.61	60	.54	7.14	7.04
101	118	5.8	0.29	66	.77	6.71	6.68
119	118	5.8	-0.002	91	.99	7.04	7.04
10	88	4.3	1.65	56	.11	7.19	6.80
19	63	3.1	-0.24	38	.81	7.28	7.34
114	63	3.1	0.75	36	.46	7.25	7.12
129	28	1.4	-0.14	13	.89	6.72	6.78
120	26	1.3	-0.88	12	.40	6.75	6.98
Total	2046	100	3.66	1198	.00	7.12	6.98

Table 8

Bed Days and ED Visits

			Hospitalized bed days					*Emergency department visits*			
Site	Age *M*	N 2011	*M bed* days 2008	*M bed* days 2011	Wilcoxon *z*	*p*	N 2011	*M ED* visits 2008	*M ED* visits 2011	Wilcoxon *z*	*p*
14	55	25	4.64	7.96	0	1.0	82	1.27	1.57	-2.1	.04
95	54	26	2.27	6.62	-.45	.66	75	1.48	1.47	-.41	.69
73	54	13	2.13	3.46	0	0	43	1.22	1.35	-.63	.53
6	52	7	3.89	3.14	-1.3	.18	43	1.35	1.70	-.52	.61
46	54	11	6.43	2.82	0	0	25	1.19	1.32	-1.0	.32
9	53	6	4.83	5.17	0	0	20	1.31	1.35	-1.0	.32
101	53	6	9.78	11.33	0	0	12	1.45	1.08	0	0
119	53	2	6.80	28.00	0	0	10	1.40	1.00	0	0
10	54	0	0	0	0	0	6	1.00	1.17	0	0
19	53	2	3.33	6.50	0	0	56	1.00	1.14	0	1.0
114	56	4	4.00	18.25	-1.0	.32	56	1.63	1.29	-1.0	.32
129	54	2	3.50	1.00	0	0	7	1.00	1.14	0	1.0
120	50	1	0	1.00	0	0	5	1.00	1.20	0	0
All	54	105	4.39	6.79	-1.1	.27	342	1.33	1.44	-2.2	.03

Note: 0 is used when there were not enough valid cases to perform the Wilcoxon Signed Rank test.

Table 9

Patient Ages, HgAlc Means, Standard Deviations, and Cohen's d

Site	Age *M*	Patients 2008 N	*M HgA1c* 2008	*SD* 2008	Patients 2011	*M HgA1c* 2011	*SD* 2011	*p*	Cohen's *d*
14	55	334	7.64	1.63	306	7.22	1.24	.00	0.29
95	54	254	6.87	1.09	301	7.00	1.19	.04	0.72
73	54	125	7.19	1.30	179	6.86	.95	.002	0.29
6	52	150	7.07	1.82	142	6.90	1.50	.289	0.10
46	54	143	6.79	1.26	157	6.83	1.22	.33	0.03
9	53	82	7.27	1.33	92	7.05	1.56	.544	0.15
101	53	97	6.88	1.24	77	6.85	1.30	.77	0.03
119	53	104	7.02	1.23	99	7.06	1.18	.99	0.04
10	54	68	7.21	1.56	68	6.92	1.33	.105	0.20
19	53	52	7.40	1.74	45	7.22	1.64	.81	0.11
114	56	49	7.15	1.28	47	7.36	1.55	.46	0.15
129	54	16	6.61	.95	24	6.75	1.18	.89	0.13
120	50	16	6.85	1.20	19	6.74	.99	.395	0.10
Total	54	1490	7.16	1.45	1556	7.01	1.27		0.11

Table 10

M Bed Days, SD, and Cohen's d

			Hospitalized bed days					
Site	Age *M*	Patients 2011	*M bed* days 2008	*M bed* days 2011	*SD* 2008	*SD* 2011	*p*	Cohen's *d*
14	55	25	4.64	7.96	5.97	15.74	1.0	0.31
95	54	26	2.27	6.62	2.19	13.52	.66	0.45
73	54	13	2.13	3.46	2.03	4.08	0	0.41
6	52	7	3.89	3.14	2.57	3.19	.18	0.26
46	54	11	6.43	2.82	4.93	1.78	0	0.97
9	53	6	4.83	5.17	4.96	7.81	0	0.05
101	53	6	9.78	11.33	13.35	18.97	0	0.10
119	53	2	6.80	28.00	6.65	36.77	0	0.80
10	54	0	0	0	0	0	0	Infinity
19	53	2	3.33	6.50	3.22	6.36	0	0.63
114	56	4	4.00	18.25	2.16	29.24	.32	0.69
129	54	2	3.50	1.00	.71	0	0	5.00
120	50	1	0	1.00	0	0	0	Infinity
Total	54	105	4.39	6.79	5.827	13.492	.27	0.24

Note: There is a significant difference in 2011 AcG RUBS ($X^2 = 43.27$, $df = 12$, $p < .000$), referrals ($X^2 = 22.95$, $df = 12$, $p < .05$) and kept appointments ($X^2 = 53.44$, $df = 12$, $p < .000$) across the military sites.

Table 11

M ED Visits, SD, and Cohen's d

Site	Age *M*	Patients 2011	*M ED* visits 2008	*M ED* visits 2011	*SD* 2008	*SD* 2011	*p*	Cohen's *d*
14	55	82	1.27	1.57	.52	1.44	.04	0.28
95	54	75	1.48	1.47	.77	.86	.69	0.01
73	54	43	1.22	1.35	.54	.65	.53	0.22
6	52	43	1.35	1.70	.91	1.25	.61	0.32
46	54	25	1.19	1.32	.40	.85	.32	0.2
9	53	20	1.31	1.35	.48	.81	.32	0.06
101	53	12	1.45	1.08	.82	.29	0	0.60
119	53	10	1.40	1.00	.97	.00	0	0.59
10	54	6	1.00	1.17	.00	.41	0	0.59
19	53	56	1.00	1.14	.00	.38	1.0	0.52
114	56	56	1.63	1.29	1.19	.49	.32	0.37
129	54	7	1.00	1.14	.00	.38	1.0	0.52
120	50	5	1.00	1.20	.00	.45	0	0.63
Total	54	342	1.33	1.44	.70	1.02	.03	0.13

Table 12

Referrals, Kept Appointment, and NCQA Scores

			Referrals					
Site	Age *M*	Patients N	DC 2011 Referrals *M*	N	Kept Appts *M*	N	% Kept Appts	NCQA Total Score
14	55	306	3.08	286	1.99	176	62%	95.75
95	54	301	2.19	236	1.62	152	64%	95.25
73	54	179	2.40	146	1.53	93	64%	92.25
6	52	142	2.30	138	1.48	79	57%	93
46	54	157	2.70	142	1.22	9	6%	92.75
9	53	92	2.47	86	1.21	14	16%	85.25
101	53	97	3.01	83	1.39	18	22%	90.5
119	53	99	2.30	71	1.11	11	16%	85.25
10	54	68	2.15	55	1.00	5	.09%	95.5
19	53	45	2.82	38	1	1	2.6%	94.5
114	56	47	2.56	43	1.00	2	.05%	95.75
129	54	24	3.57	23	1.00	3	13%	78.25
120	50	19	2.73	15	1.86	7	47%	92.5
Total	54	1556	2.59	1362	1.66	570	42%	91.27

Table 13

Patients, Mean HgA1c, and ACG RUB

Site	Age *M*	Patients 2011	*M HgA1c* 2011	ACG RUB 2008 *M*	ACG RUB 2011 *M*
14	55	306	7.22	3.15	3.12
95	54	301	7.00	3.21	3.32
73	54	179	6.86	3.13	3.34
6	52	142	6.90	3.10	3.16
46	54	157	6.84	3.30	3.47
9	53	92	7.06	3.07	3.21
101	53	97	6.85	3.31	3.40
119	53	99	7.07	3.36	3.26
10	54	68	6.92	3.16	3.27
19	53	45	7.22	3.40	3.21
114	56	47	7.36	3.32	3.32
129	54	24	6.75	3.36	3.54
120	50	19	6.75	2.92	3.19
Total	54	1556	7.01	3.20	3.27

There is a significant difference in 2011 AcG RUBS ($X^2 = 43.27$, $df = 12$, $p < .000$), referrals ($X^2 = 22.95$, $df = 12$, $p < .05$), and kept appointments ($X^2 = 53.44$, $df = 12$, $p < .000$) across the military sites.

Table 14

NCQA Standards Scores

Site	Patients N	Kept appts *M*	N	% kept appts	NCQA total score	PCC1 access/ comm	PCC2 tracking	PCC3 case mgmt	PCC4 self-mgmt support	PCC5 electron. Rx	PCC6 test trackg.	PCC7 referral trackg.	PCC8 perform. rptg.	PCC9 adv. comm..
14	306	1.99	176	62%	95.75	9	21	15	5	8	13	4	15	0.75
95	301	1.62	152	64%	95.25	7.75	20.5	20	6	8	13	4	14.5	1.50
73	179	1.53	93	64%	92.25	9	21	20	5	4.5	13	4	14.5	1.25
6	142	1.48	79	57%	93	7.75	20	19	5	8	13	4	14.25	2
46	157	1.22	9	6%	92.75	7.75	19.5	19.25	5	7.5	13	4	15	1.75
9	92	1.21	14	16%	85.25	7.75	17.5	15	6	6.75	13	4	14.5	0.75
101	97	1.39	18	22%	90.5	7.75	18	18.75	5	7.25	13	4	15	1.75
119	99	1.11	11	16%	85.25	7.75	17.5	15	6	6.75	13	4	14.5	0.75
10	68	1.00	5	.09%	95.5	7.75	20.5	20	5	7.25	13	4	15	3
19	45	1	1	2.6%	94.5	7.75	20.5	19.25	6	7.5	13	4	14.5	2
114	47	1.00	2	.05%	95.75	9	21	15	5	8	13	4	15	0.75
129	24	1.00	3	13%	78.25	7.75	12	15	2	8	13	4	15	1.5
120	19	1.86	7	47%	92.5	7.75	20.25	20	5	8	9.5	4	15	3
Total	1556	1.66	570	42%	91.27	8.03	19.2	17.8	5	7.4	12.8	4	14.8	1.6

Table 15

HgA1c Differences in 2008 and 2011 by Race

	Sum of Squares	*df*	Mean Square	*F*	Sig.
HgAlc Avg 2008:					
Between groups	28.178	4	7.045	3.626	.006
Within groups	1655.212	852	1.943		
Total	1683.390	856			
HgA1c Avg 2001:					
Between groups	16.470	4	4.117	2.734	.028
Within groups	1420.050	943	1.506		
Total	1436.520	947			

There is a significant improvement in *HgA1c* from 2008 to 2011 in Whites, Asians, Blacks and Other races. In 2008, $F = 3.63$, $df = 4/852$, $p = .006$; in 2011, $F = 2.73$, $df = 4/943$, $p = .028$.

Table 16

Hospitalized Days and *ED Visits* in 2008 and 2011 by Race

	Test Statistics [ab]			
	Hospitalized days 2008	*Hospitalized days* 2011	*ED visits* 2008	*ED visits* 2011
Chi-square	3.855	3.980	.738	.342
df	3.000	3.000	4.000	3.000
Asymp Sig.	.278	.264	.947	.952

[a] Kruskal Wallis Test

[b] Grouping variable: Race

Table 17

Hospitalized Days and *ED Visits* in 2008 and 2011 by Gender

	Test Statistics [a]			
	Hospitalized days 2008	*Hospitalized days* 2011	*ED visits* 2008	*ED visits* 2011
Mann-Whitney U	1209.500	1200.000	14684.000	12780.500
Wilcoxon W	2385.500	3030.000	28880.000	29616.500
Z	- .104	- .998	- .147	- 2.517
Asymp Sig. (2-tailed)	.917	.318	.883	.012

[a] Grouping variable: Gender

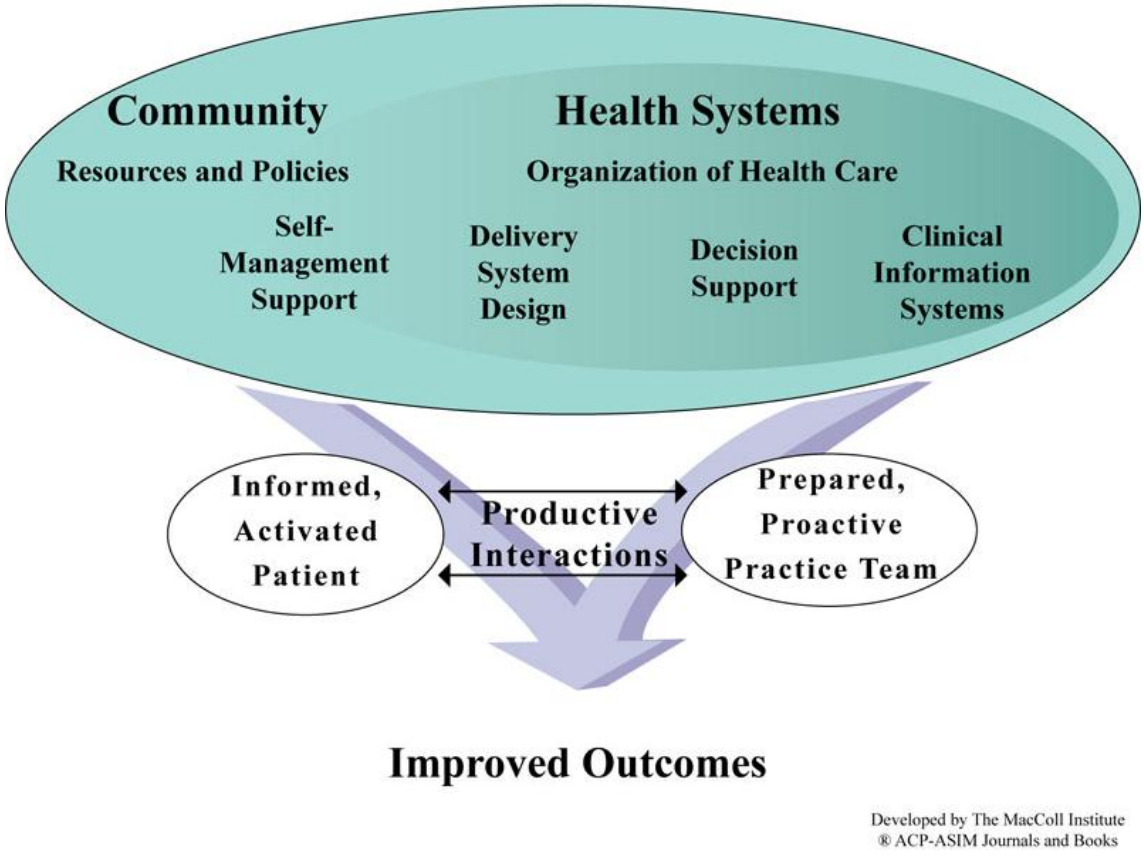

Figure 1. The Chronic Care Model.

	dc_referrals _2011	dc_kept_referral_appts _2011	ACG_RUB _2011
Chi-square	43.268	22.953	53.438
df	12	12	12
Asymp. Sig.	.000	.028	.000

a. Kruskal-Wallis Test

b. Grouping Variable: dmis

Figure 2. Test Statistics[a,b] Kruskal-Wallis Test.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.018[a]	.000	.000	1.247	.000	.418	1	1290	.518	
2	.058[b]	.003	.002	1.246	.003	3.981	1	1289	.046	
3	.101[c]	.010	.008	1.242	.007	8.754	1	1288	.003	
4	.101[d]	.010	.007	1.242	.000	.001	1	1287	.975	
5	.101[e]	.010	.006	1.243	.000	.060	1	1286	.807	
6	.103[f]	.011	.006	1.243	.000	.640	1	1285	.424	
7	.117[g]	.014	.008	1.242	.003	3.826	1	1284	.051	
8	.120[h]	.014	.008	1.242	.001	1.020	1	1283	.313	1.912

a. Predictors: (Constant), PPC1 Access and Communication (9.00),
b. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00),
c. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00)
d. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC4 Pt Self-Mgmt Support (6.00)
e. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC4 Pt Self-Mgmt Support (6.00), PPC5 Electronic Prescribing (8.00)
f. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC4 Pt Self-Mgmt Support (6.00), PPC5 Electronic Prescribing (8.00), PPC6 Test Tracking (13.00)
g. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC4 Pt Self-Mgmt Support (6.00), PPC5 Electronic Prescribing (8.00), PPC6 Test Tracking (13.00), PPC8 Performance Rptng & Improvement (15.00)
h. Predictors: (Constant), PPC1 Access and Communication (9.00), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC4 Pt Self-Mgmt Support (6.00), PPC5 Electronic Prescribing (8.00), PPC6 Test Tracking (13.00), PPC8 Performance Rptng & Improvement (15.00), PPC9 Advanced Electronic Communication (4.00)
i. Dependent variable: A1c_avg_2011

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.056[a]	.003	.002	1.248	.003	4.235	1	1367	.040
2	.087[b]	.008	.006	1.246	.004	6.146	1	1366	.013
3	.108[c]	.012	.009	1.244	.004	5.593	1	1365	.018

a. Predictors: (Constant), PPC2 Pt Tracking & Registry Fxs (21.00)
b. Predictors: (Constant), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00)
c. Predictors: (Constant), PPC2 Pt Tracking & Registry Fxs (21.00), PPC3 Care Management (20.00), PPC8 Performance Rptng & Improvement (15.00)

Figure 3. NCQA Standards Regressed Against *HgA1c*.

Chapter Four: Summary and Conclusion

Summary

This study evaluated three hypotheses:

Hypothesis 1: There is a difference in outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) for T2DM patients exposed to pre- and post-implementation of PCMH in military clinics.

Hypothesis 2: There are differences in the outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) of T2DM patient groups across 15 USAF clinic facilities.

Hypothesis 3: Variation in recognition scores on the nine NCQA PPC®-PCMH™ standards explain variation in outcomes (*HgA1c*, *ED visits*, and *hospitalized days*) among patients with T2DM seen in military clinics.

The first hypothesis evaluated patient-level data to investigate the effect of PCMH implementation on specific patient outcomes of *HgA1c*, *ED visits*, and *hospitalized days*. *HgA1c* was evaluated using *t-test*, and *ED visits* and *hospitalized days* with the non-parametric Wilcoxon Signed Ranks Test. There was a significant effect on *HgA1c* at three facilities, but two of those showed an improvement while the other showed a decline in *HgA1c*. Overall, there was an improvement of *HgA1c* from 2008 to 2011, but that improvement did not reach significance. Both *ED visits* and *hospitalized days* increased, reflecting a decline in performance, although that increase did not reach significance. Hypothesis 1 was rejected overall.

The second hypothesis compared the 13 sites with each other to see if one site had a particularly good PCMH program that impacted patient outcomes. This hypothesis was evaluated using ANOVA for *HgA1c* and the non-parametric Kruskal-Wallis *H* test.

Results revealed that the sites were not significantly different in *HgA1c* values in 2008, but they were significantly different in 2011 (p = .024 and p = .023, respectively). There was a significant effect of PCMH implementation on *HgA1c*, $F(11, 1543) = 1.97$, $p <. 05$ and as noted in Table 7, the mean *HgA1c* went down from a *M* of 7.12 in 2008 to a *M* of 6.98 in 2011 (p = .00). There was no significant improvement in *ED visits* from 2008: $H(12) = 16.0$, $p > .04$, to 2011, $H(12) = 14.83$, $p > .05$. There was also no significant reduction in *hospitalized days* from 2008, $H(11) = 16.91$, $p > .05$, to 2011, $H(11) = 12.24$, $p > .05$. Hypothesis 2 was supported for *HgA1c* but not for *ED visits* or *hospitalized days*.

The third hypothesis studied whether NCQA PPC®-PCMH™ recognition scores explained variation in patient outcomes. Since neither variable of *hospitalized days* and *ED visits* met the assumption of normality, both were omitted from regression analysis of this hypothesis. NCQA standards did not yield a significant model that explained variation in *HgA1c*. Only three of eight standards contribute to explaining variation in *HgA1c*. Patient tracking (PPC2) explained 0.3% of the variation in *HgA1c*, care management (PPC3) explained 0.7%, and performance reporting and improvement (PPC8) explained 0.3%. Rerunning multiple regression with just those three standards resulted in a model that explained 0.09% of the variation in *HgA1c*, so it is a very weak model. Thus, Hypothesis 3 was rejected.

Only one of the two sites that reflected positive significance in *HgA1c* measurement (sites 14 and 73) also showed improvement in ACG RUB. Of the three sites that showed improvement in ACG RUB (sites 14, 19, and 119), only two of those

(sites 14 and 19) were among the eight MTFs (14, 73, 6, 9, 101, 10, 19, and 120) that showed an improvement (a decrease) in Mean *HgA1c* between 2008 and 2011.

Hospitalized days and *ED visits* showed similar trends that did not point to any one particular area of significance. *Hospitalized days* showed improvement (decrease) at only three MTFs (sites 6, 46, and 129), with large effect size noted at one of those facilities (site 46), which would indicate further investigation in their practices and processes might be warranted. Similarly, Mean *ED visits* showed improvement (decrease) at only four MTFs (site 95, 101, 119, and 114). Only one of those sites with a decrease in Mean *ED visits* (101) was a site that had shown an improvement in Mean *HgA1c*, and a different site (119) is the only one that showed decreased *ED visits* and improved ACG RUB. Multiple small connections can be made, but, overall, there seems to be no indication of a particularly strong or weak aspect of the PCMH program in regards to management of patients with T2DM.

NCQA PPC®-PCMH™ recognition does not explain variation in *HgA1c*. One goal of this study had been to be able to inform individual sites what elements of the NCQA standards explain their outcomes, but that is not possible, because most standards did not make a significant contribution to explaining variation in *HgA1c.* Only three standards offered any contribution: patient tracking (PPC2) explained 0.3% of the variation in *HgA1c*, care management (PPC3) explained 0.7%, and performance reporting and improvement (PPC8) explained 0.3%. When just those standards were used to rerun multiple regression (see Figure 3), the result was a model that explained just 0.09% of the variation in *HgA1c*. If more variability was possible, such as a wider variation of NCQA scores, the results might be different.

However, a wider range of NCQA PPC®-PCMH™ recognition scores might reflect an overall decrease in the level of quality of care provided at each site, which would not be desirable. The low level of variation in NCQA PPC®-PCMH™ recognition scores may simply reflect that skilled professionals have already been working regularly to deliver high quality care with good patient outcomes (controlled *HgA1c* values) and almost no *ED visits* or *hospitalizations*. Given that situation, existing as it did even before the new program was implemented, meant that even major care delivery changes cannot make a major difference in already great or good outcomes. The new care paradigm of PCMH in the USAF had little opportunity to improve already consistent results. Results of this study reflect that the military has been doing an outstanding job with a challenging population and even a superior care delivery method has little chance to improve the outcomes.

Conclusion

This portfolio brings together an investigation of the effect of PCMH on selected patient outcomes for patients seen in military clinics. Chapter 1 provides an overview of the project, with an emphasis on the background of PCMH, including its basis on the theory of the Chronic Care Model (PCPCC, 2007). A literature review provides the foundation for the importance of this study in assessing management of care for patients with the chronic disease of type-2 diabetes mellitus. The review also illustrates the literature gap evident in studies regarding CCM for patients with T2DM in military settings.

Chapter 2 is a manuscript submitted to the journal *AAACN Viewpoint*, a peer-reviewed, bimonthly publication for nursing professionals that is the official newsletter of

the American Academy of Ambulatory Care Nursing (AAACN). Editorial staff has indicated their intention to publish the manuscript in the future. This manuscript describes the process for PCMH implementation that was followed by the USAF. This reflects first-hand experience of the primary investigator, as a member of the first USAF PCMH (then called Family Health Initiative) implementation team.

Chapter 3 is a manuscript that will be submitted to *Nursing Economic$: The Journal for Health Care Leaders*. *Nursing Economic$* is a refereed journal with a purpose to ". . . advance nursing leadership in health care, with a focus on tomorrow, by providing information and thoughtful analyses of content and emerging best practices in health care management, economics and policymaking" (Jannetti Publications, 2013). This manuscript briefly describes PCMH, the design and methods of the study being conducted, and the results of the study.

Chapter 4 is this Summary and Conclusion, putting all pieces of the portfolio together, how they relate to each other, and the significance of each.

The portfolio continues with all references that are included in Chapters 1 and 4, and the appendices, which include approval to use the CCM diagram, a copy of the request to obtain retrospective data from the USAF EMR, University of Texas at Tyler IRB exempt approval, and USAF Research Oversight & Compliance Division exempt approval. The portfolio is made complete with a Biosketch of the primary investigator.

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Appendix A: Request to use the Diagram of the Chronic Care Model

WAECP1117033

April 6, 2011

University of Texas at Tyler

Dear Ms. Andrews;

Thank you for your request to print the following from *Effective Clinical Practice:*

Figure 1, Effective Clinical Practice, 1998, Vol1, Chronic Disease Management: What Will It Take to Improve Care for Chronic Illness? Wagner EH

Permission is granted to print the preceding material with the understanding that you will give appropriate credit to *Effective Clinical Practice* as the original source of the material. Any translated version must carry a disclaimer stating that the American College of Physicians is not responsible for the accuracy of the translation. This permission grants non-exclusive, worldwide rights for this edition in print for not for profit only. ACP does not grant permission to reproduce entire articles or chapters on the Internet unless explicit permission is given. This letter represents the agreement between ACP and University of Texas at Tyler for request WAECP1117033 and supersedes all prior terms from the requestor.

Thank you for your interest in Annals of Internal Medicine. If you have any further questions or would like to discuss the matter further, please contact me at 856-489-8555 or fax 856-489-4449. Sincerely,

Gina Brown
Permissions Coordinator

Appendix B: AFMSA AF/SG6H Data Request, Agreement, and Authorization Form

AF/SG6H DATA REQUEST, AGREEMENT AND AUTHORIZATION FORM

Fill out all applicable areas of the form, sign, and submit via e-mail (scanned attachment with signature), fax, or mail to:

Health Care Informatics Division, AF/SG6H
3515 S. General McMullen, Ste 200
San Antonio, TX 78226-1865
FAX : (DSN) 395-9864
david.carnahan@us.af.mil (COMM) 210 395 9778
Susan.chao@us.af.mil (COMM) 210 395 9780

SECTION A: REQUESTOR INFORMATION

Name: (Last, First MI)	Andrews, Carol A. B.		
Rank/Grade:	Colonel		
Position/Title:	Director, Compliance Function		
Organization:	AFMOA		
Office Symbol:	SGHH		
Email Address:	Carol.andrews@us.af.mil		
Phone: (Commercial)	210-395-9133	(DSN)	969-9133

SECTION B: INTENDED USE OF REQUESTED DATA

B1 - PURPOSE OF THE TASKING/STUDY/PROJECT REQUIRING DATA
(Please provide explicit reasons for needing the requested data):

All AF MTFs have been directed by AF/SG to implement Patient Centered Medical Home (PCMH). All MTFs will have implemented by Jan 12. Patient outcome data of patients with diabetes will be used to evaluate the effectiveness of PCMH implementation and of National Committee on Quality Assessment (NCQA) Recognition. This evaluation will be used as part of the requestor's dissertation, as well as to inform AFMOA's Medical Home Cell.

B2 - IS THE REQUESTED DATA USED TO SUPPORT RESEARCH?

☒ **YES** ☐ **NO** (Check One) If "Yes," then comply with statements in Section E.

Research is defined by the Code of Federal Regulations (CFR §46.102) as: a systematic investigation, including research development, testing and evaluation, design to develop, or contribute to generalizable knowledge.

B3- DOES THE REQUESTED DATA INCLUDE PERSONAL IDENTIFIERS(S)?

☐ **YES** ☒ **NO** (Check One) If "Yes," then comply with statements in Section D.

Examples of personal identifiers: SSAN, date of birth, combination of gender, race, and rank when the sample is less than 50.

AF/SG6H DATA REQUEST, AGREEMENT AND AUTHORIZATION FORM

B4 - INFORMATION ON HOW THE DATA WILL BE STORED:
(Describe in detail computer security precautions and physical security of facilities and containers where the data is placed for safekeeping.)

Will be stored in work computer utilizing a password. Access to building/office space is limited only to those with a security badge/password. Will also be stored in external hard drive to be used on school computer kept at home – both external hard drive and school computer are password-protected and home is locked.

B5 - INDIVIDUALS AUTHORIZED TO ACCESS THE REQUESTED DATA:
(List any additional authorized users on a separate page and attach to this request.)

Name	Rank	Organization	Position/Title
Andrews, Carol A. B.	Col	AFMOA	Director, Compliance
Northam, Sally		Univ of Texas at Tyler	Faculty; Student Advisor

SECTION C: DATA REQUEST SPECIFICS

C1 –TYPES OF DATA REQUESTED:
Check all that apply.

- ☒ 1. Direct Care Outpatient
- ☐ 2. Direct Care Inpatient
- ☒ 3. Network Outpatient
- ☐ 4. Network Inpatient
- ☐ 5. Fitness Data
- ☐ 6. Personnel Data
- ☐ 7. Enrollment Data
- ☐ 8. Immunization Records
- ☐ 9. Pharmacy Data
- ☐ 10. Other (Please Specify Below)

Other Data Type(s):

C2 –TIME FRAME: (e.g., CY, FY, etc.)
CY10

C3 - SELECTION CRITERIA/POPULATION: (e.g., ADAF, men, enrollees, etc.)

All eligible beneficiaries enrolled in TRICARE Prime and TRICARE Plus from the following 15 MTFs:
Edwards
Scott
Patrick
F.E. Warren
Hill
Laughlin
Elmendorf
Lakenheath
Davis Monthan
Shaw
Travis

AF/SG6H DATA REQUEST, AGREEMENT AND AUTHORIZATION FORM

Keesler
Luke
Langley
Wright-Patterson

Adults (18 yo or older)
- Can be AD, retiree, or dependent

Diagnosed Type 2 Diabetes
- Include ICD-9 codes:
  - 250. (diabetes)
  - 357.2 (polyneuropathy)
  - 362.0 (diabetic retinopathy)
  - 366.41 (diabetic cataract)
- Do NOT include:
  - 648.0 (gestational diabetes)
  - Type 1 diabetes

C4 - DATA ELEMENTS: (List in a separate sheet, if necessary)

- Number of patients with type 2 diabetes enrolled continuously to 15 MTFs
- Beneficiary status
- Age
- Gender
- Race
- Education level
- HgbA1c value
- ACG variables, to include number of Emergency Department visits, number of hospitalized days, number of referrals, and number of referral encounters (total referral visits)
- ACG RUB

C5 - OUTPUT FORMAT: (e.g., Microsoft Excel, comma delimited flat file, etc.)

Microsoft Excel

C6 - OTHER SPECIFIC INSTRUCTIONS: (Complete and detailed instruction can expedite the process.)

Data elements described above collected at 15 MTFs during the following two time periods:

Pre- PCMH: March 2008 – August 2008

Post PCMH: June 2011 – November 2011

SECTION D: DATA USE AGREEMENT (For all data requests)

AF/SG6H DATA REQUEST, AGREEMENT AND AUTHORIZATION FORM

1. The requestor will not disclose, release, or otherwise disseminate the data to anyone not covered by this document. Access to this data will be limited to a minimum number of individuals necessary to achieve the purpose and to those individuals on a need-to-know basis.
2. The requestor is aware of the Privacy Act of 1974 and the Health Insurance Portability and Accountability Act of 1996 pertaining to safeguarding personal information. The requestor will assure these requirements are followed to protect the confidentiality of the data and prevent unauthorized disclosure, use, or access to it.
3. The requestor agrees that no findings, listing, or information derived from the requested data, with or without identifiers, may be released if such findings, listing or information contain any combination of data elements that might allow the deduction of an individual's identification without first obtaining written authorization.
4. By signing this agreement the requestor acknowledges that this relationship will be governed by the listed clauses and all applicable current and future Federal, DoD, and USAF regulations. All data transferred must be encrypted using an approved FIPS 140-2 compliant tool. Data will be accessed using the current PKI standard. For the purpose of this agreement the requestor may use a CAC or Software Certificate. Small data sets will be transferred using encrypted email.
5. Data will only be used for the specified purpose.
6. Data will not be incorporated into any database of record.
7. It is the requestor's responsibility to destroy all copies of the data immediately after it fulfills its intended use.
8. The requestor must certify the destruction of the data files in writing within 30 days of completion of the specified purpose or at closure of IRB and send this certification to:

AF/SG6H
3515 S. General McMullen, Ste 200
San Antonio, TX 78226-1865
FAX: (DSN) 395-9864 (COMM) (210) 395-9778

9. No data or parts of data will be retained when the files are destroyed.

AF/SG6H DATA REQUEST, AGREEMENT AND AUTHORIZATION FORM

SECTION E: DATA USE AGREEMENT (For data requests supporting research)

1. The requestor certifies the requested data will be used for research conducted in accordance with Air Force Instructions 40-402 and 40-403. (http://www.e-publishing.af.mil/)

2. The requestor is aware federal regulations allow certain kinds of research to be exempt from full review by an Institutional Review Board (IRB), given that certain criteria are met. The requestor has reviewed these criteria, which are discussed at the Air Force Medical support Agency, Clinical and Biomedical Research and Development Division website: https://www.afms.mil/sgx/sgxc.

3. An Air Force sponsored IRB is required to review research proposal.

4. In the case this research does not meet the exemption criteria; the research protocol has undergone full review by an Air Force sponsored IRB and has received authorization. In this case, the authorization letter from the IRB and a copy of the IRB application are attached.

SECTION F: ATTACHMENTS

Please list all attachments to this document.

None

SECTION G: SIGNATURES

The undersigned agree to the provisions in this document:

Carol A. B. Andrews 12 Jun 12

Signature of Data Requestor Date

Kimberly A. Slawinski 25 Jun 12

Signature of Director/Chief of Organization Requesting Data | Printed Name/Title | Date

Appendix C: Andrews' IRB Exempt Approval

The University of Texas at Tyler
Institutional Review Board

September 24, 2012

Dear Ms. Andrews,

Your request to conduct the study entitled: *Evaluation Of An Innovative Program To Improve Outcomes Among Military Beneficiaries With Diabetes*, IRB #F2012-11 has been approved by The University of Texas at Tyler Institutional Review Board as an exempt study. Please note that the IRB protocol Andrews #Sum2012-60 is immediately discontinued. This approval includes a waiver of written informed consent. Please be aware of the following:

- Prompt reporting to the UT Tyler IRB of any proposed changes to this research activity must be done by the PI
- Prompt reporting to the UT Tyler IRB and academic department administration will be done of any unanticipated problems involving risks to subjects or others must be done by the PI
- Suspension or termination of approval may be implemented if there is evidence of any serious or continuing noncompliance with Federal Regulations or any aberrations in original proposal.
- Any change in proposal procedures must be promptly reported by the PI to the IRB prior to implementing any changes except when necessary to eliminate apparent immediate hazards to the subject.

Best of luck in your research, and please do not hesitate to contact any member of the IRB or me if we can be of any assistance.

Sincerely,

Gloria Duke, PhD, RN
Chair, UT Tyler IRB

Appendix D: Approval Letter/Concur with Exempt Determination

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

NOV 15 2012

MEMORANDUM FOR THE UNIVERSITY OF TEXAS AT TYLER
ATTN: CAROL A. B. ANDREWS, COL, USAF, NC

FROM: AFMSA/SGE-C
Research Oversight & Compliance Division
7700 Arlington Blvd. Ste. 5151
Falls Church, VA 22042-5151

SUBJECT: Surgeon General's Human and Animal Research Panel (SGHARP) Review of FSG20120008E

References: (a) 32 CFR 219, Protection of Human Subjects
(b) 10 USC 980, Limitation on Use of Humans as Experimental Subjects
(c) AFI 40-402, Protection of Human Subjects in Research
(d) DoDI 3216.02, Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research

On behalf of the Air Force Surgeon General, our office, AFMSA/SGE-C has reviewed and concurs with your Institution's exempt determination for the following study:

FSG20120008E, "Evaluation of an Innovative Program to Improve Outcomes among Military Beneficiaries with Diabetes".

To assist in the proper accomplishment of this study, please ensure compliance with the above references, including Reference (c), as it pertains to annual progress reports, final reports, proper maintenance of records, and the application of written informed consent to all study participants.

JAMES BENJACK, Lt Col, USAF, BSC
Director, Research Oversight & Compliance Division

Biosketch

NAME Carol A. B. Andrews eRA COMMONS USER NAME	POSITION TITLE Primary Investigator --

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
University of Texas Health Science Center at San Antonio	BS	05/1980	Nursing
University of Texas at Tyler	MS	12/1982	Interdisciplinary Studies
University of Texas, Tyler	PhD	05/2013	Nursing

A. Positions and Honors.

Positions:

United States Air Force 56th Medical Group, Luke AFB, AZ Jul 2012-Present
- Chief Nurse

United States Air Force Air Force Medical Operations Agency, San Antonio, TX Jul 2007-Jul 2012
- Chief, Compliance and Communication Cell
- Senior Program Manager, Care Coordination
- Air Force Surgeon General's Consultant for Ambulatory Care Nursing
- Population Health Consultant, Population Health Support Division

United States Air Force 12th Medical Group, Randolph AFB, TX Aug 2004-Jul 2007
- Chief Nurse
- Patient Safety Program Manager
- Chief, Education and Training

United States Air Force 48th Medical Group, RAF Lakenheath UK Jan 2001-Aug 2004
- Deputy Chief Nurse
- Deputy Squadron Commander
- Primary Access Flight Commander
- Nurse Manager, Family Practice Clinic

United States Air Force 6th Medical Group, MacDill AFB, FL Feb 1998-Jan 2001

- Chief, Health Care Integration
- Nurse Manager, Family Practice Clinic
- Medical Group Executive Officer

United States Air Force 12th Medical Group, Randolph AFB, TX Oct 1994-Feb 1998

- Put Prevention Into Practice Coordinator
- Infection Control Officer
- Clinical Nurse, Family Practice Clinic

United States Air Force 10th Tactical Fighter Wing Medical Clinic, RAF Upwood, UK Aug 1992-Oct 1994

- Health Promotion Manager

United States Air Force Wilford Hall Medical Center, Lackland AFB, TX Oct 1987-Aug 1992

- Charge Nurse, Post Anesthesia Care Unit
- Staff Nurse, Cardiothoracic Unit

Audie Murphy VA Hospital San Antonio, TX Nov 1984-Jul 1987

- Staff Nurse, Nurse Administered Unit
- Staff Nurse, Neurology Unit

Home Health Home Care Del Rio, TX and San Antonio, TX Aug 1983-Nov 1984

- Staff Nurse

Medical Center Hospital Tyler, TX Aug 1980-Apr 1983

- Staff Nurse, MSICU, Telemetry, Neurology, and Oncology Units

Honors:

- Who's Who Among Students in American Universities and Colleges – 2011
- AF Major General Barbara C. Brannon Nursing Leadership Award – 2006
- AETC Major General Barbara C. Brannon Nursing Leadership Award – 2006
- AETC Major General Barbara C. Brannon Nursing Leadership Award – 2005
- AAACN Excellence in Administrative Ambulatory Nursing Practice Award – 2005
- 48th Medical Group Field Grade Nurse of the Year – 2003
- 12th Medical Group Field Grade Nurse of the Year – 1997

B. Publications (Project Related)

Selected peer-reviewed publications (in chronological order).

- Reviewer *Ambulatory Care Nursing Orientation and Competency Assessment Guide, 2nd ed.* – 2010
- Co-author *DoD Medical Management Guide version 3.0* – 2009
- Co-author *Ambulatory Care Nursing Administration & Practice Standards, 7th ed.* – 2007