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Complete Care Model Impact on Glycemic Control in California State Prisons

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ABSTRACT

COMPLETE CARE MODEL IMPACT ON GLYCEMIC CONTROL IN CALIFORNIA STATE PRISONS

The Complete Care Model (CCM) is a health care delivery model based on the well-studied and internationally validated chronic care theory. Since the integration of the chronic care theory into California Department of Corrections and Rehabilitation (CDCR) patient care in 2008, steady improvement in health care related mortality has been seen, and there have been no unavoidable health care related deaths in CDCR since 2012 (Gransee, 2018). However glycemic control in CDCR diabetic patients has made no statistically significant change since the implementation of the CCM in 2015 when comparing the two years before and the two years after implementation of the CCM. According to the literature, this suggests that key components of the model have yet to be fully incorporated into the CCM (Stellefson et al., 2013). The CCM has been shown to be effective in bringing about positive change in the CDCR health care delivery, but the theory was not implemented robustly enough to achieve CDCR's goal of 90% of all their diabetic patients having glycated hemoglobin (HbA1c) levels less than 8%. Further research and development of the CCM is still needed to reach the diabetic patient care goals associated with the full adoption of the chronic care theory.

Diane M. O'Laughlin
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COMPLETE CARE MODEL IMPACT ON GLYCEMIC CONTROL IN CALIFORNIA STATE PRISONS

by

Diane M. O'Laughlin

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We, the undersigned, certify that the project of the following student meets the required standards of scholarship, format, and style of the university and the student's graduate degree program for the awarding of the Doctor of Nursing Practice degree.

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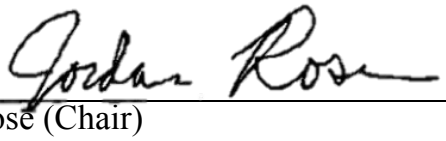

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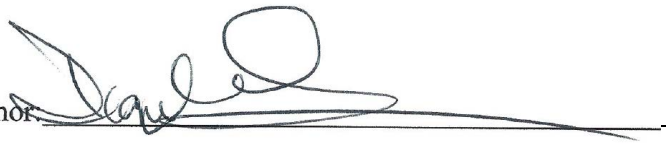
Signature of project author: 

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CHAPTER 1: INTRODUCTION

Diabetes in the Correctional Setting

Over 2 million people are housed in American prisons and jails, and of these inmates, over 80,000 are diagnosed with type 2 diabetes (American Diabetes Association [ADA], 2014). Patients with diabetes who do not keep their blood sugar levels well-controlled have a higher risk of premature death, more microvascular issues, and increased macrovascular complications (ADA, 2016b). Glycemic control for most individual patients is glycated hemoglobin (HbA1c) levels less than 7%; however, HbA1c less than 8% is consistent with the National Committee for Quality Assurance Healthcare Effectiveness Data and Information Set (HEDIS) standards for glycemic control (National Committee for Quality Assurance [NCQA], 2018).

Diabetes is difficult for patients to manage in any setting. Disease management is not only dependent on medical care but is also dependent on the patient developing a novel lifestyle of nutritional therapy and adopting exercise as a habit, and is further heavily influenced by patient psychosocial, economic, and educational factors (Altuntas, Abl, & Ozturk, 2014). Incarceration is the loss of personal freedom (Austin, 2016). In the prison setting, the inmates lose the ability to choose what they will eat; when, how, and if they will be allowed to exercise; and what health care options are available to them. These rigid circumstances increase the complexity of diabetic disease management and comorbidity control, leading to increased patient vulnerability.

Patients diagnosed with diabetes, on an average, have approximately 2.3 times higher medical costs than patients absent of diabetes. The ADA states patients with diabetes incur average medical expenditures of $16,752 per year, of which $9,601 is directly attributed to treatment of diabetes, or 57.31% of total health care costs. The ADA's ten-year study from 2007 to 2017 showed that total treatment costs for diabetes care in the United States increased by 66%, from $205 billion to $327 billion annually. ADA research shows patients with diabetes have a 30% higher hospitalization rate than non-diabetic patients. Costs associated with treating diabetes are expected to continue to rise 5 to 6% per year for the next several years (ADA, 2018).

In California, 2.3 billion taxpayer dollars are budgeted for health care in California Department of Corrections and Rehabilitation (CDCR) for the fiscal year 2018–2019 (Legislative Analyst Office, 2018). The expenses related to correctional health care have consistently risen over the past 10 years. This increase in spending is influenced by both the rising cost of health care in the community and the prevalence of chronic diseases such as diabetes and the associated comorbidities such as kidney failure, heart disease, blindness, and amputations in the aging prison population (Ahalt, Trestman, Rich, Greifinger, & Williams, 2013). The current CDCR population had stabilized at approximately 115,000 inmates as of 2015 (Goss & Hayes, 2018). Per the California Correctional Health Care Services' (CCHCS) Deputy Director of Quality Management, the CDCR houses approximately 8,000 diabetic inmates at any given time (J. Dunlap, personal communication, March 1, 2019). This indicates that approximately 7% of the CDCR inmate population have diabetes.

Background: Health Care in CDCR

Historically, prisons have not provided adequate and consistent health care to the inmates in their custody. In California, various lawsuits since 1995 have alleged serious gaps in health care services provided within the state prison system (Austin, 2016). In 2001, the United States District Courts found the CDCR health care to be in violation of the United States Constitution's Eighth Amendment, which prohibits cruel and unusual punishment. CDCR was not able to remedy the quality in medical care as was directed by the court, and thus their medical health care services were placed under the direction of Federal Receivership on October 3, 2005 (Gransee, 2018).

The purpose of the Federal Receivership was to guide CDCR toward an acceptable health care program for the state's wards, the California inmate population. The Receiver's vision statement directed that "As soon as practical, California Correctional Health Care Services (CCHCS) will provide constitutionally adequate medical care to patient-inmates of the California Department of Corrections and Rehabilitation (CDCR) within a delivery system the State can successfully manage and sustain." The mission of CCHCS was to "reduce avoidable morbidity and mortality and protect public health by providing inmates timely access to safe, effective and efficient care, and integrate delivery of medical care with mental health, dental, and disability programs." (California Prison Health Care Receivership, 2009, p. i). In 2008, CCHCS was established to oversee CDCR's health care (Gransee, 2018) and leaders selected the chronic care theory as the Federal Receiver's team's conceptual framework for improving health care for the inmate population (Ha & Robinson, 2011; Vansickle, 2018).

Chronic Care Theory

The chronic care theory is accepted nationally and internationally as an evidence-based conceptual model to improve patient health care outcomes for patients with chronic conditions (Ha & Robinson, 2011). The patient-centered medical home (PCMH) model is also based on—and is considered by many a re-branding of—the chronic care theory (Kilo & Wasson, 2010).

History and Theoretical Assumptions of the Chronic Care Theory

In 1999, Edward Wagner, a physician in Puget Sound, Washington, authored the chronic care theory to provide effective care for those with chronic illnesses. The overarching goal of the theory is to coordinate health care disciplines to improve the quality of care for patients with these diseases. Wagner designed the theory after completing an extensive literature review and interviews with a broad spectrum of health care experts about effective ways to treat patients with chronic diseases. The Robert Woods Foundation funded additional development of the theory and employed an advisory board of 40 interdisciplinary health care experts to further refine Wagner's work (Wagner, Davis, Schaefer, Von Korff, & Austin, 1999).

Assumptions of the chronic care theory state that planned and scheduled care of the chronically ill by an interdisciplinary team leads to better patient outcomes. Wagner states that "tyranny of the urgent" is a powerful driver of suboptimal care. Acute needs of a patient can easily overshadow less pressing interventions required to manage chronic illness. When time is too short for the provider to do patient teaching about managing or preventing chronic disease, the patient remains uneducated and rarely becomes an active partner in disease control. The theory also advocates for division of labor, wherein all members of

the health care team are responsible for parts of the care of the patient. Wagner asserts that an educated patient and a prepared interdisciplinary team increase patient satisfaction and the efficiency of patient care (Bodenheimer, Wagner, & Grumbach, 2002).

Concepts of the Chronic Care Theory

The chronic care theory has six concepts. These concepts are interrelated and are designed to work together to improve the health of the patient and reinforce the patient's relationship to the health team. (Fiandt, 2006).

1. Team-based patient-centered care: This involves the creation of interdisciplinary care teams who divide the labor needed to provide for planned and proactive patient care.
2. Patient self-management support: Building skills, educating, and problem solving with the patient are central to this concept.
3. Information technology: Computer-based patient registries to track and trend disease control indicators are essential to effectively managing the patient cohort.
4. Evidence-based clinical guidelines for patients and providers: Detailed evidence-based care plans and protocols ensure patient care adheres to current standards of care.
5. Community programs: Referrals to resources such as exercise groups or specialists outside the clinic are vital for patient support and increase the efficacy of the clinic.
6. Health systems: Leadership support for funding and strategic planning are critical for implementing chronic care theory and attaining patient goals (Bodenheimer et al., 2002).

Wagner and his team explain the relationship between the six concepts in the following way: To give anticipatory care (team-based, patient-centered care), the team must be able to readily track patient data (information technology) and have access to current standards of practice (clinical guidelines), both of which require leadership support to develop (health systems). Patients must be willing to participate in the care (self-management support) and have support systems (community) outside the clinic which further develops self-efficacy (Coleman, Austin, Branch, & Wagner, 2009). A meta-analysis of the use of the chronic care theory in various settings supports Wagner's statement of interdependence between the six concepts and concludes that all six are needed to improve patient care (Elissen et al., 2013).

Used worldwide, the chronic care theory is an evidence-based conceptual model to improve patient health care outcomes for patients with chronic conditions. The chronic care theory has been extensively studied for efficacy in the literature (Elissen et al., 2013). Multiple studies support the chronic care theory as an effective approach for improving compliance to standards of care, educating patients, and increasing the self-efficacy of patients (Barletta et al., 2016). By 2004, the theory had been adopted by over 1,000 health care settings in the United States of America. On an international level, the World Health Organization (WHO) endorsed the chronic care theory and used it as the foundation for the design of WHO's innovative care for chronic conditions framework (Epping-Jordan, Pruitt, Bengoa, & Wagner, 2004).

Chronic Care Theory for Diabetics

Multiple studies have determined the efficacy of the chronic care theory for diabetic patients specifically. A rigorous review from 2013 started with 155

studies relating to chronic care and diabetes from the Cochrane database of systematic reviews. The review included randomized trials, prospective cohort studies, natural experiments, qualitative studies, and cross-sectional studies. The researchers concurred that when all six of the concepts of the chronic care theory are implemented, the application of the theory is successful in increasing patient involvement in self-care, reducing patient HbA1c, and increasing adherence to ADA standards of care (Stellefson, Dipnarine, & Stopka, 2013).

The Complete Care Model in Corrections

The complete care model (CCM) is the health care delivery model designed by CCHCS. The model is based on the chronic care theory. In 2015, the CCHCS implemented their CCM in all CDCR prisons. The model established a "medical home" for patients and assigned each patient to a specific primary care team (PCT). The PCT, at a minimum, is comprised of a primary care provider (PCP), a Registered Nurse (RN), and a support staff person, such as an office technician (OT). The PCT "organizes and coordinates services, resources, and programs to ensure consistent delivery of appropriate, timely and patient-centered, evidence-based care to a designated patient panel" (California Correctional Health Care Services [CCHCS], 2017b, p. 2). The PCT directs patients to the correctional dental providers, mental health providers, medical providers, and nursing care within the prison. When patient needs exceed the scope of the services offered by the correctional interdisciplinary health care providers, the PCT arranges for patient care with specialists outside the facility (CCHCS, 2017b).

Practices established by the CCM policy include PCT morning huddles and planned population management. The PCT meets together daily to review and discuss patient care issues, patient follow up appointments, new patients to the

panel, patients transferring to another prison, medication administration, supplies, staffing, and any other issue which may impact the patient care and clinic efficacy. Additionally, each PCT has a working meeting twice monthly together with their executive leadership to review their patient panel from a population perspective. Statewide registries have been established so that the PCT can efficiently review their care team data and determine which labs and studies are due, according to both patient diagnoses and patient risk stratification. Additionally, during these population review meetings, updates in patient care guidelines are discussed (CCHCS, 2016).

The data included in the CCHCS statewide registries, which include patient HgbA1c levels, blood pressure levels, hepatitis C testing data, and immunization status are also uploaded in an aggregated non-patient specific format for public view in the CCHCS dashboard. This data is easily accessible to the public via the CCHCS website (CCHCS, 2019). In this way, CCHCS works to remain transparent and accountable to the public regarding their care of the inmates.

CCHCS has authored evidence-based diabetic care guides for the PCTs. These guidelines cover medication management, high-level dietary and exercise recommendations, preventative care, comorbidity guidelines, and follow-up care parameters. The care guides also provide general patient education material (CCHCS, 2018). What is not robust in the CCM is the provision of ongoing nutritional counseling, exercise training, or mental health involvement in the management of the diabetic patient, all of which is recognized as standard management of this disease (ADA, 2016b).

Analysis of the CCM Implementation

The chronic care theory literature indicates that fully implementing all six components of the theory should improve the glycemic control of the diabetics in the practice. It is therefore important to evaluate which of these components were adopted in the 2015 implementation of the CCM. The six essential components of the chronic care theory are (a) team-based patient-centered care, (b) patient self-management support, (c) information technology, (d) evidence-based clinical guidelines for patients and providers, (e) community programs, and (f) health system with leadership support (Bodenheimer et al., 2002).

Primary care teams (PCT) were implemented at all 35 California state prisons by the end of 2015. Robust policy was written to support the design and use of these teams for addressing patient care needs. The PCT is designed to include a minimum of the medical provider, RN, and an OT. Mental health providers, pharmacists, dieticians and dental representatives, however, were not directed to be included in a PCT panel for this implementation (CCHCS, 2016).

Patient self-management is a challenge in the correctional setting. The essence of imprisonment is the loss of personal freedom. Choices in diet, exercise, and self-care are limited in the prison setting. On-site dieticians and diets designed for patients with chronic diseases, such as diabetes or kidney disease for example, are not available to every prison (CCHCS, 2018). The budget for the standard CDCR diet is $3.32 per day (Fox, 2017).

Per Alice Nicolai, the dietician at California State Prison, Sacramento, the standard daily menu provides 2,700 calories per day, and is 52% carbohydrate, 30% fat and 18% protein. Per Ms. Nicolai, the high percentage of carbohydrates served is because it is an inexpensive way to provide an adequate number of calories on such a small budget (personal communication, October 25, 2017).

Evidence-based guidelines include carbohydrate restriction as central to glycemic control for diabetic patients and has been shown to reduce diabetic patients' dependence on medications with significant side effects and expense (Feinman et al., 2015).

A policy to allow inmates to own a glucometer to monitor their own blood sugars was initiated in 2009 (Ball, 2011). However, per the CCHCS Statewide Deputy Director, Statewide Nurse Executive, this program is not consistently used in all CDCR institutions (J. Robinson, personal communication, March 26, 2019). Consistent prescription of personal glucometers for diabetic inmates would further support the individual nutritional therapy needs and self-efficacy of these patients.

Information technology is one of the six essential components of the chronic care theory. The CCM policy supports the use of computer-based patient registries for various chronic diseases (CCHCS, 2016), and these registries have been available to health care correctional staff since 2012 (J. Dunlap, personal communication, March 31, 2019). The implementation of the electronic record was an essential component of the Federal Receiver's plan for patient care improvement. However, the introduction of electronic health records is broadly recognized in the health care industry as a disruptive technology, and its implementation ushers in not only the intended opportunities for improved patient care, but also the unintended risks associated with introducing rapid paced and sweeping change within the organization (Sulmansy, Lopez, & Horwitch, 2017).

The implementation of the CCHCS Electronic Health Record (EHR) project was challenging for the organization. The initial implementation of the EHR in 2015 had to be restarted in 2016 due to pharmacy interface issues (National Association of State Chief Information Officers, 2018). This disruptive technology was therefore introduced twice during the post-CCM period studied.

The off-the-shelf Cerner electronic health record product purchased for CCHCS is adaptable to the unique needs of the correctional setting (National Association of State Chief Information Officers, 2018). However, many of the chronic-care-theory-based decision support tools used pre-CCM for planned care do not yet exist in the Cerner product (J. Robinson, personal communication, March 26, 2019). The clinical support tools lost during the implementation of the CCHCS EHR are considered standard safety features for high performing health care organizations (Sulmansy, Lopez, & Horwitch, 2017).

Community program involvement for CDCR patients includes referral to medical and dental specialists outside the prison setting and some volunteer programs such as Narcotics Anonymous inside the correctional setting when patient needs exceed the scope of the correctional health care professionals. Routine health coaching from correctional educators or contract services such as transcendental meditation are still nascent concepts in the correctional health care setting.

Quality Improvement Project

In 2018, to assess effectiveness of a more complete adoption of the CCM, a CCHCS clinical psychologist facilitated a small CDCR quality improvement project, which incorporated additional components of standard evidence-based diabetic care. The project involved 10 diabetic men from a CDCR institution who volunteered to participate in this health care improvement project for three months. The group used the PCT as established in the CCM policy but added a fuller complement of community resources as recommended by the ADA. Resources included collaboration with the correctional physical education teacher to provide coaching for a daily workout and a dietician borrowed from a

neighboring institution to meet for individual nutritional counseling for one hour with each of the men every 14 days. The project also enlisted the services of a psychologist to run a group meeting once weekly about the behavioral aspects of diabetic management. To improve the self-efficacy in these patients, these 10 men were provided their own glucometers and given education on how to use the device. In addition, the institutional executives met monthly with this enhanced care team to assess the group's progress and needs. No change was made in the menu offered to the participants (J. Roberts, personal communication, April 5, 2019).

This group did show improvement in their glycemic control. The mean HbA1c level for the group at the start of the program was 9% and was reduced to 8.2% after three months in the program. Additionally, the mean weight and blood pressure of the project participants also improved. At the conclusion of the three months, the participants were invited to a meeting to give their feedback to the executive staff. The message from the patients was they felt their care mattered to the team, which motivated them towards improved self-care. The participants unanimously advocated to the leadership for a menu with fewer carbohydrates and more vegetables to assist them to further their self-efficacy in glycemic control (J. Roberts, personal communication, April 5, 2019). The sample size of this health care improvement project was too small to determine significance or make generalizations. However, this project does suggest a need for further studies on the impact of a fuller adoption of the chronic care theory in the correctional setting to improve health care outcomes.

Purpose of this Study

The CCHCS dashboard states their goal is for more than 90% of their diabetic inmates to have HbA1c levels below 8%, which is consistent with the HEDIS standards for glycemic control (CCHCS, 2017a; NCQA, 2018). CCHCS leadership asked for a study of the efficacy of the CCM in the correctional setting and assisted with the design of this study. HbA1c level is a known key indicator for a competent implementation of the chronic care theory, which is the theoretical foundation of the CCM (Stellefson, Dipnarine, & Stopka, 2013). The goal of this study was to evaluate the efficacy of the CCM as implemented in 2015 for attaining the National Committee for Quality Assurance goals for HbA1c levels in the CDCR diabetic population in order to determine if more robust implementation is warranted.

CHAPTER 2: LITERATURE REVIEW

Chronic Care Theory in the Literature

While there is much literature about the successful application of the chronic care theory in health care for the non-incarcerated individuals worldwide (Elissen et al., 2013), there is a shortage of research conducted on the chronic care theory applied in the correctional setting. Neither this population, nor this setting, is well-represented in current literature per Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, or Google Scholar searches using keywords such as California Corrections and diabetes, California Correctional Health Care Services and diabetes, nor Complete Care Model and diabetes.

In a longitudinal retrospective study, Gates and Bradford (2015) assessed the effect of incarceration on weight gain and chronic diseases such as diabetes, hypertension, and hyperlipidemia. The sample size was 2,932 individuals in the Georgia state correctional setting, 93% of whom were male, and 7% of whom were female. Sixty-five percent of the sample was White, 32% were of sub-Saharan decent, and 32% identified with various other ethnicities. The average age of the incarcerated individuals in this study was 40 years of age, and the average incarceration term was two years. The data showed an average weight gain of 0.96 kg during incarceration. The one-sample *t* test showed the variation in weight gain by population was significant ($p= 0.000$): The change in body mass index (BMI) for women was 7.97 times greater than the change in BMI for men. Surprisingly, patients with diabetes did not have a significant change in BMI in the Georgia correctional setting; this is a strong finding and is not well understood. The study was unique in its strength of sample size and length of time studied.

One of the limitations of this study was the relatively small percentage of the sample (7%) which was female.

Ha and Robinson (2011) performed a quantitative study related to the initiation of a program based on the chronic care theory in the California state prison system in 2009. Though this study is more than 5 years old, it is a primary resource and provides baseline data for current assessment of the CCM in California state prisons. California inmates in this study averaged 37 years of age, although 13% of the inmates were over 50 years of age. Each prison has the capacity to house approximately 5,000 inmates. The six components of chronic care theory were customized to function within the correctional setting and to target asthmatic patients because poorly controlled asthma was the leading cause of preventable death in the California state prisons at that time. Six pilot prisons collected key indicator data six months after the start of the program.

Key indicators were manually audited from paper charts and the hand-tallied reports were forwarded to headquarters for analysis. Key indicators included asthma severity assessments with every asthmatic clinic visit, appropriate treatment with anti-inflammatory medication for persistent asthmatics, the number of symptom free days, and the presence of an asthma action plan for all asthmatic patients. Patient complaints were also tracked over the six-month pilot period. Additionally, responses from 61 Likert-like surveys of employees regarding their perceptions of patient care and program development were reviewed. Data from the prisons were tallied and appear in bar graph format in the report.

The results showed that after six months in the program based on the chronic care theory, the pilot institutions' asthma severity index compliance range from 70 to 95%; appropriate use of anti-inflammatory treatment range from 65 to 98%; documented asthma action plan compliance range from 10 to 93%; number

of symptom free days for asthmatics was reported in both numbers and percentages, indicating confusion on reporting data, and were not calculated in the report. Patient complaints were 21% lower in the prisons who piloted the chronic care theory program in contrast to the other California state prisons during this period. The staff surveys showed 59% of staff perceived improved patient outcomes six months after adoption of the chronic care theory. The study did not have longitudinal data, nor have data on the control set, nor robust statistics on the data collected.

Jordan-Joseph (2016) presented a quantitative study conducted in the correctional setting showing the efficacy of a pharmacist-led diabetic education program called diabetes self-management education. The program setting was the all-male Devens Federal Medical Center in Massachusetts, using data over 12 months in 2014. The program, like the chronic care theory, focused on the patient learning to care for himself with the support of an interdisciplinary care team but led by a pharmacist. The parameters for acceptance into the programs was an HbA1c score of 9.5% or higher and willingness to change behavior. The sample size ranged from 29 to 32 patients. Patients were discharged from the program when they had two HbA1c values in a row scored at 7.5% or lower. Data collection was HbA1c levels drawn, tracked, and reported in bar graphs quarterly via a simple spreadsheet format.

The results of the intervention showed the cohort's HbA1c levels trended down from 9.4 to 8.6% over 12 months, with 16 inmates being discharged from the program for meeting the 7.5% HbA1c goal. Patients discharged from the program started with a mean HbA1c baseline of 10.82% and, when discharged, had a mean HbA1c of 7.35%. The study demonstrated significant improvement in

HbA1c levels in the participating diabetic patients. The study did not measure behavior changes and addressed only a small sample size of only male patients.

A quasi-experimental study from Oregon explored the impact of altering the food offered to diabetics in the correctional setting (Firth, Sazie, Hedberg, Drach, & Maher, 2015). The study queried whether female prisoners participating in a lower calorie menu called the healthy food access plan (HFAP) had different biometric data after a year on the program when compared to female prisoners who continued with the usual prison diet. The patients in the study averaged 46 years of age, of whom 75% were non-Hispanic Whites and 65% of the patients already had a diabetes diagnosis before entering the prison.

On August 28, 2013, the authors collected data from two women's correctional facilities in Oregon. Two groups were studied: 24 women in the minimum facility were fed a lower-calorie HFAP menu starting on August 1, 2012, and 39 women who were incarcerated in the adjacent medium security prison received the standard larger-calorie meals. Data were collected for all the diabetic patients who had resided in either facility for more than 90 days. The collected data were from 12 months before the start of the HFAP program through 12 months after the start of HFAP program. Data included HbA1c levels, BMI, age, race, cholesterol levels, and length of prison term. The authors hand-audited the paper charts. The independent variables were lipid levels, HbA1c levels, and BMIs. The dependent variable was participation in the HFAP program.

Data analysis included independent variable comparison between the two groups via linear mixed effect models. Random intercept was added to the models to account for variance in the baseline data. The model fit was verified via residual plots and statistics. Significance level was set at .05 and the results of the study showed a significant HbA1c reduction of 0.04% per month for the women

participating in the HFAP program. BMI and cholesterol changes were not significant between the two groups. While this study used strong statistical analysis, the patient movement between facilities and the lack of consideration of medication's role in glycemic control were confounding factors.

Fan et al. (2014) conducted a quantitative study to assess the efficacy of the 2005 version of the Patient Assessment of Care for Chronic Conditions (PACIC) survey. Their 20-question survey tool was designed to assess the efficacy of programs based on the chronic care theory from the patient's perspective; however, the tool had not been robustly tested regarding its five factorial features: patient activation; delivery system design/decision support; goal setting/tailoring; problem-solving/contextual; follow-up/coordination. To gather a sample with which to test the tool, 4,796 randomly sampled adult patients with type 2 diabetes were sent the PACIC survey. The 2,055 responding patients' average age was 64.9 years old, 50.4% male, and 30.8% single, 50% high school graduates, 98.8% Caucasian, and 98.7% with insurance coverage. The sample was drawn from 34 primary care clinics in the Midwest region of the United States. The intervention was a rigorous assessment of the five factors of the tool, since there had been concerns about the subscale scores. The authors performed correlation studies to assess the relationship between subscales using Pearson correlation, and consistency internally was tested by Cronbach's alpha test. As the result of the analysis, a new four-factor framework was created, which had less variance in the subscale scores and improved internal consistency with Cronbach's alpha test. The new factors included evaluation of services provided; personal goal setting and action plan; inclusion and collaboration with the healthcare team; and getting help and support from a social network. The PACIC is a valuable tool for assessing the efficacy of programs based on the chronic care theory. Although the

authors used strong, complex statistical tests for analysis of the tool, they made it clear that the results of the study could not be generalized for all populations.

A quantitative cross-sectional survey measured Medicaid diabetic patients' perception of the efficacy of the patient-centered medical home (PCMH) model in Los Angeles, California in 2014. The researchers examined whether patients in a low-socioeconomic milieu experienced better diabetic care within a PCMH structure. The selection of the study sample was a two-step process. The authors randomly selected 100 out of the 471 private physician practices in the Los Angeles area who reported having a medical-home-type structure. They asked each of these practices to submit the contact information for 10 Medicaid type 2 diabetic patients who were between the ages of 18 and 65 years of age and had at least a six-month history in the physician's practice. The selected patients were contacted by their physician's office and asked if they wished to be referred to the study or to opt out.

One fifth of the 949 patients referred had incorrect contact information and were thus excluded from the study. Of the remaining 635 patients, 540 patients responded to the survey and were included in the study. One percent of the sample was either Armenian or Mandarin speaking, 43.7% English speaking, and 55.3% Spanish speaking. Seventy-two percent of the sample were unemployed, and 56% of the sample did not have high school diplomas. Gender was not queried.

The tool used in this study was the Primary Care Assessment Tool (PCAT) Adult Expanded (AE). Shi, Starfield, and Xu validated this survey tool in 2001. The tool was normed on low-socioeconomic patients in South Carolina. Using a set of 96 questions, the survey tool reviews patient perspective in the following seven domains of patient care: cultural competency, family-centric care,

community-based care, care coordination, comprehensiveness of care, care continuity, and care upon first contact. Multiple researchers administered the survey, following the PCAT-AE script. Each answer was scored on a Likert-type scale. In addition to medical home scores, self-reported demographics including race, education, overall state of health, as well as diabetic education and care were compiled. A bivariate analysis was done to consider differences in the medical home scores in light of the demographic data. Analysis of variance (ANOVA) was used on the medical home scores, and the chi-square test was applied to the demographics to check for the significance of differences in the sample. Finally, logistic regression testing was used on the medical home scores for diabetic care and education and controlled for demographics.

The authors excluded seven surveys from the sample due to missing answers. The study reported that for people on Medicaid, the enrollment in a medical-home-type practice was more predictive of good diabetic care and education than any other demographic. This study added to the body of evidence supporting the patient perception that the medical-home-type model improves care for diabetic patients. A limitation of this study was the self-reporting nature of the tool used, which may have provided data that were neither objective, nor accurate (Stevens et al., 2014).

The Veterans Health Administration (VHA) examined the impact the PCMH model had on their patients' diabetic control between the years 2008 and 2012. Their qualitative research was designed as a retrospective cohort and multilevel logistic regression study. The specific research question attempted to assess improvement in VHA diabetic patients' glycemic control and lipid levels since the implementation of their medical home model in 2010. The researchers also examined the impact of the medical home model on non-Hispanic Black

patients and on women, since these two populations have a historical disparity in care. The study sample included 20,858 VHA patients over the age of 18 who were within a VHA network in the midwestern region of the United States. Inclusion factors were diagnostic codes for diabetes, a prescription for diabetic medication, or two blood glucose readings over 200 mg/dl recorded in the EHR. Demographics for the sample were 97.7% male and 78.4% non-Hispanic. Racial/ethnic groups outside non-Hispanic Black or White were excluded, as diabetic patients from these groups were not of sufficient number in the VHA during the period being researched.

The researchers obtained the lab results for HbA1c and low-density lipoprotein cholesterol (LDL-C) on all the patients in the selected cohort between 2008 and 2012 from the VHA databank. HbA1c and LDL-C were validated as reliable tests used to assess glycemic and lipid control in diabetic patients (NCQA, 2018). The VHA data was collected by query from the database by doctoral-level researchers. The percentage of VHA patients with HbA1c less than 9% and LDL-C less than 100 mg/dl were collected for the years 2009 and 2012. A set of bivariate multilevel logistic regression models examined the relationship between time and outcome and was compared against demographics. Significant relationships in the data were plotted in a slope analysis. The authors used International Business Machines (IBM) Statistical Package for Social Services (SPSS) Statistics version 23 to generate multilevel logistic regression with generalized linear models.

The study results indicated that despite the implementation of the medical home model in the VHA in 2010, glycemic control in the patients studied was inferior, and there were no gains in lipid control. A major strength in this study was the sample size being over 20,000 patients, while a limitation was the narrow

demographics of the sample, which was 97% male and 77.2% White. While this demographic may adequately reflect the VHA clientele in the Midwest, the results cannot be generalized to the broader demographics in society (Woodard et al., 2018).

Summary of the Literature

This review of seven studies regarding practices based in chronic care theory and diabetes management elucidates perspectives to consider when designing a well-rounded glycemic control program in the correctional milieu. There is both strong support for use of chronic-care-theory-based models for managing diabetes, and there are also gaps noted in the literature. The results from the Georgia state prison obesity study show that patients with diabetes in their chronic-care-theory-based program did not gain weight, whereas general population inmates, who were not enrolled in the chronic-care-theory-based program, did gain weight while incarcerated. The authors called out a need for further study of the protective aspect the application of chronic care theory had on weight gain in the correctional setting (Gates & Bradford, 2015).

In California, the model based on the chronic care theory showed initial success in asthma management during a 2009 six-prison pilot. While the initial data from the CCHCS pilot was promising, full implementation of the chronic care theory had yet to be realized for diabetes management in this population. Ha and Robinson (2011) called for longitudinal studies as the adoption of the theory matured and expanded in California state prisons.

Inclusion of the food services manager in the multidisciplinary care team brought innovative menu ideas to a women's prison in Oregon. The study attributed a monthly 0.04% decrease in HbA1c levels to the inmates having a

dietitian work with the inmates. This demonstrated both the community support and patient skill-building components central to the CCM. These authors called for larger studies of diabetic inmate health care strategies (Firth, Sazie, Hedberg, Drach, & Maher, 2015).

The diabetes self-management education structure had an oversight board and a strong connection to interdisciplinary team members which included dieticians and exercise guidance personnel. These effective strategies align well with the care design outlined in the chronic care theory. Jordan-Joseph reported a dearth of data relating to diabetic self-care in prison and called out for more studies on diabetes care strategies for the incarcerated population. Diabetes self-management education also had a robust behavior modification module (Jordan-Joseph, 2016); CCHCS has the resources to add behavior modification strategies to their CCM via their mental health services.

While the PACIC summary was designed to assess usefulness of chronic-care-theory-based programs from the patients' perspective, the tool still needs to be validated for the correctional setting. The Assessment of Chronic Illness Care (ACIC) survey, however, is less population specific and may, therefore, be more efficient to assess the CCM program based on the chronic care theory from the care team perspective. The ACIC is designed to support continuous quality improvement and has potential to be a useful and valid tool to assess the efficacy of the CCM diabetic management program (Fan et al., 2014).

The VHA study did not show a positive outcome for diabetic patients in their PCMH study, but the sample was a very narrow demographic (Woodard et al., 2018). Testing the broader demographic of incarcerated patients treated for diabetes with the CCM, which is based on the same theory, could provide additional insight into the efficacy of this approach to diabetes management.

The study of Medicaid patients in PCMH settings was based on patient-reported data about their diabetic care. While this study had encouraging data regarding the quality of diabetic care, the data were subjective and may not have been accurate (Stevens et al., 2014). A study based on the objective HbA1c test data would be well suited to assess the clinical efficacy of CCM.

Significance of the Current Study

The aim of the current study was to add to the body of knowledge regarding current implementation of correctional diabetic care, with the hope of improving health care outcomes while reducing the costly complications of poor glycemic control for all incarcerated diabetics. Examining data for the impact the CCM has on CCHCS diabetic patients builds on the work done by other researchers and provides evidence-based data for both clinical and non-clinical correctional leadership regarding health care priorities, including funding and further programming.

As CCHCS transitions from Federal Receivership control to control by the prison wardens, it is imperative to assess data for the efficacy of the CCM for health care management and the avoidance of costly comorbidities related to poorly controlled disease. This study aimed to have a meaningful impact on the future of health care design for inmates. Where the 2014 model has been effective in improving inmate health, these best practices are shared with other correctional health care organizations to broaden the implementation of this model in prisons worldwide. Where the 2015 iteration of CCM has not been effective in improving health care significantly, according to the concept of distributive justice, CCHCS can ethically explore and adopt additional health care interventions to improve health care in this population.

Research Question

The following research question was posed to assess the impact of the CCM implementation as it relates to the HbA1c of CDCR's diabetic inmate population:

In CDCR, is the percentage of diabetic inmates statewide whose HbA1c is less than 8% different during the two years after the implementation of CCM in 2015 when compared to the same HbA1c data during the two years prior to the implementation?

CHAPTER 3: METHODOLOGY

Research Design

The research project was a quantitative study, designed to be a longitudinal, retrospective cohort study, which was non-experimental in nature and analyzed the results of a program in which all California inmates have been enrolled since 2015. This study compared the glycemic control of California diabetic inmates during the two years before the implementation of the CCM (2013–2014) to the two years after (2016–2017) in order to examine the impact of the CCM on glycemic control of CDCR's inmate population diagnosed with diabetes. The HbA1c measurements for all statewide diabetic inmates were included.

The outcome variable for the study was the percentage of diabetic patients statewide whose HbA1c level was below 8%, which is a key indicator for glycemic control in the CCHCS system. HbA1c is a valid and reliable test for assessing diabetic control and has been normed on patients internationally (Saudek & Brick, 2009). HbA1c less than 8% is the level at which the National Committee for Quality Assurance Healthcare Effectiveness Data and Information Set (HEDIS) determines that the blood sugar is in control (NCQA, 2017). Data analysis was performed with the non-parabolic Wilcoxon test. The diabetic inmate cohort before the CCM implementation was the control group, and the cohort after the intervention was the treatment group. The alpha level was set to 0.05.

Sampling Procedure

The data used for this study are contained in the CCHCS dashboard, which is published monthly on the CCHCS website. The dashboard data are at the population level, indicating what percentage of the total diabetic population has

HbA1c levels below 8%. The dashboard data include all inmates with diabetes who have been within the CCHCS system for at least twelve months. Data sources for patient inclusion in the dashboard as a diabetic are based on data gleaned from the Patient Health Information Portal, Guardian Pharmacy Database, Strategic Offender Management System, Electronic Health Record (EHR), Quest Diagnostics Laboratory Database, and Third-Party Administrator Claims (CCHCS, 2017a).

CCHCS leadership granted approval for this project, with the caveat that the study be based on publicly accessible data. California State University (CSU), Fresno Institutional Review Board (IRB) approved the project. Though the study was based on publicly accessible data, the author did not assess the data for this study until approval was granted by both CCHCS leadership and CSU, Fresno IRB on October 10, 2018. See appendix A, for tables listing HbA1c data gleaned from the CCHCS dashboard and a listing of the acronyms used as the naming convention for these facilities. The study's data were extracted from the CCHCS dashboard without name or identification numbers, therefore consent from individual patients was not necessary. The aggregated data of all incarcerated patients with diabetes already exist in California on the CCHCS dashboard, thus maximum participation was assured, and recruitment was unnecessary. As these were aggregated data, the subjects could not be identified and were not able to be compensated individually.

Patient Risk

Since this study was retrospective, using a public data source related to a quality improvement intervention implemented in 2015, no known psychological, social, physical, or economic risk to the sample population was anticipated. There

were no special procedures such as electrical equipment, radioisotopes, or investigational new drugs involved. There was no violation of normal expectations for patient care anticipated in this study. As these data are publicly available, there was no data security risk present. This was a quantitative study and, therefore, no coding was used.

Studies of inmates have specific risks. Biomedical research on prisoners is prohibited by law. The legality of studying the prison population was carefully managed by following the parameters of the 2016 California Senate Bill (SB) 1238. SB-1238 authorizes "records-based biomedical research involving inmates that uses existing information, but which does not include prospective interaction with human subjects" (Inmates: Biomedical data, 2016). The CCM is not an experimental program; all inmates in the state of California were enrolled in this program for quality improvement in 2015, and this proposed study was retrospective in design. This study was in line with SB-1238, which further specifies that banned biomedical research "does not include the accumulation of statistical data in the assessment of the effectiveness of nonexperimental public health programs or treatment programs in which inmates routinely participate" (Inmates: Biomedical data, 2016). Further, this study qualified as an exempt human research study under Exemption 4 per the National Institutes of Health training for human subjects research (National Institutes of Health [NIH], 2018).

Data Exclusion

Data from the year the CCM was implemented statewide, 2015, was excluded due to inconsistency of the data; during 2015, some prisons used the CCM, while other prisons had not yet implemented the CCM. Additionally, two prisons first opened during the timeframe covered by this study. These are

California Health Care Facility (CHCF) and California City Correctional Facility (CAC). Since these two institutions could not provide the full four years of HbA1c data, both pre- and post-CCM data from these institutions were excluded from the study.

Risk to Internal Validity

The loss of subjects to parole and addition of newly-convicted inmates to the cohort was a risk to this study's internal validity (Vansickle, 2018). However, the study assessed a large sample size of 8,000 diabetic inmates represented in the data at any given time. Further, there was a 12-month CDCR residency parameter for inclusion in the dashboard. These two factors mitigated the risk (J. Dunlap, personal communication, July 29, 2018; Knapp, 2017). The use of aggregated data posed the risk of missing outliers. For this reason, a Mood's median test was used to add statistical validity. Additionally, the format of the CCHCS dashboard was updated June 2013, thus the data from January to May 2013 was in a slightly different format. CCHCS quality management team was available to answer questions about their earlier format.

CHAPTER 4: RESULTS

Sample Description

The percentage of diabetic patients whose HbA1c values were less than 8% during the years 2013, 2014, 2016, and 2017 in the California state prisons was examined. These glycemic control data are reported publicly on the CCHCS dashboard monthly for each of the 35 California state prisons. Therefore, glycemic control data for the years 2013, 2014, 2016, and 2017, provided 1,680 (35 prisons x 12 months x 4 years) potential data points. The statewide facility glycemic control percentages reflect the entire diabetic population incarcerated in CDCR; there were approximately 8,000 diabetics at any given point in time during the study (J. Dunlap, personal communication, March 1, 2019). The CCHCS dashboard glossary describes the data inclusion requirement as having been incarcerated in CDCR continuously for 12 months, and the data include patients from age 18 to age 75 (CCHCS, 2017a).

Since the prison population before the initiation of the CCM (pre-CCM) was compared to the prison population after the initiation of the CCM (post-CCM), a paired *t* test was planned to analyze the impact of this intervention. However, since the normality of difference between the pre-CCM and post-CCM produced a bimodal histogram, the non-parametric Wilcoxon test was the more reliable test to compare the means of these two groups (Knapp, 2017). There were not complete data available for two of the 35 prisons: Two prisons first opened during the timeframe covered by this study and could therefore not provide the full four years of HbA1c data both pre- and post-CCM. Data from these institutions were excluded from the study. The remaining 1,584 data points were used to compute an adjusted monthly glycemic control percentage for the entire statewide

population. The statewide average calculation resulted in 24 data points for the two years pre-CCM and 24 data points for the two years post-CCM; these were then used in the Wilcoxon test for the data set. The Mood's median test was performed on the full 1,584 data points from the 33-institution dashboard data set to test for outlier data, and to thereby improve the statistical validity of the study.

All data in this study only pertained to individuals over the age of 18, as only adult institutions were included in this study. The majority of the included population is male, since thirty-one of the prisons assessed in the study are male institutions, and only two of the prisons in the study are female institutions. The United States 2010 census shows prisoner ethnicity in the state of California were 9% White, 14% Hispanic, 58% Black, and 19% other ethnicities (Sakala, 2014).

Research Question Results

When the results were compared between the groups, the data showed that there was no statistically significant change in the percentage of diabetic inmates statewide whose HbA1c was less than 8%.

The null hypothesis was that there was no difference between the percentage of diabetic inmates statewide whose HbA1c was less than 8% during the two years after the implementation of CCM in 2015 when compared to the same HbA1c data during the two years prior to the implementation.

The alternative hypothesis was there was a difference between the percentage of diabetic inmates statewide whose HbA1c was less than 8% during the two years after the implementation of CCM in 2015 when compared to the same HbA1c data during the two years prior to the implementation.

The mean value was used for the Wilcoxon test. The mean for statewide diabetic population whose HbA1c was below 8% pre-CCM, was 77%. The mean

value for the population, post-CCM, was 78%. The normality of differences for the pre-CCM and post-CCM groups was mildly skewed, so the non-parametric Wilcoxon test rather than a paired *t* test was used to verify the comparison of means (Knapp, 2017). The Wilcoxon test indicated a *p* value of .063. The null hypothesis was therefore accepted. There was no statistically significant difference between the percentage of diabetic inmates statewide whose HbA1c is less than 8% during the two years after the implementation of CCM in 2015 when compared to the same HbA1c data during the two years prior to the implementation (see Figure 1).

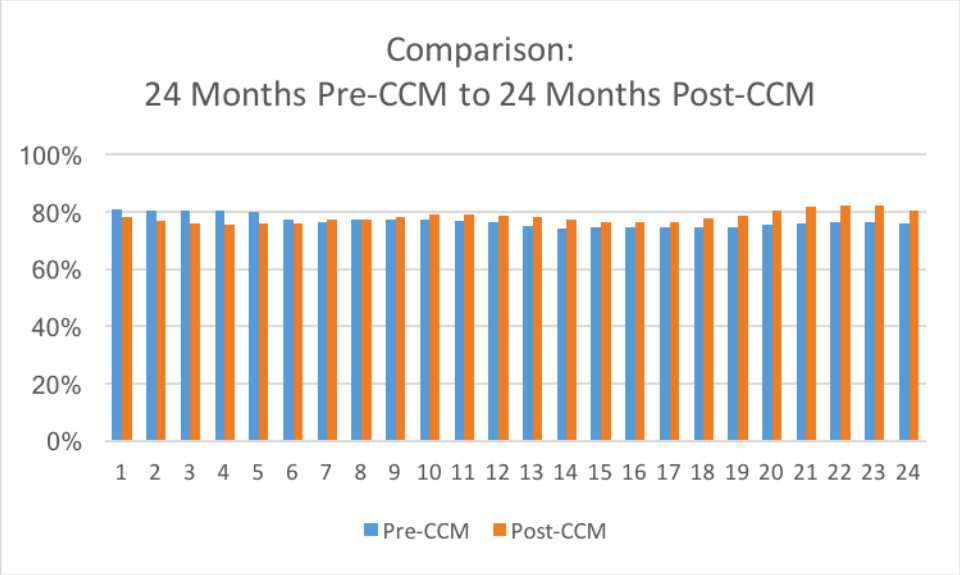

Figure 1. Monthly means for percentage of all diabetic patients in glycemic control: Comparing the 24 months pre-CCM (2013–2014) to the 24 months post-CCM (2016–2017).

Mood's median test on the CCHCS data showed a median of 0.775 or 78% for statewide diabetic patients having HbA1c less than 8% during the period studied. The Mood's median test is robust for central tendency of data and has no

requirement for normalcy between groups (Knapp, 2017). Of the 1,596 data points included in the study, 389 were above the median pre-CCM, while 409 data points were above the median post-CCM. The significance of this difference per the Yates' Continuity Correction Chi-Square was 0.515. The Mood's median test further supported the acceptance of the null hypothesis (see Figure 2).

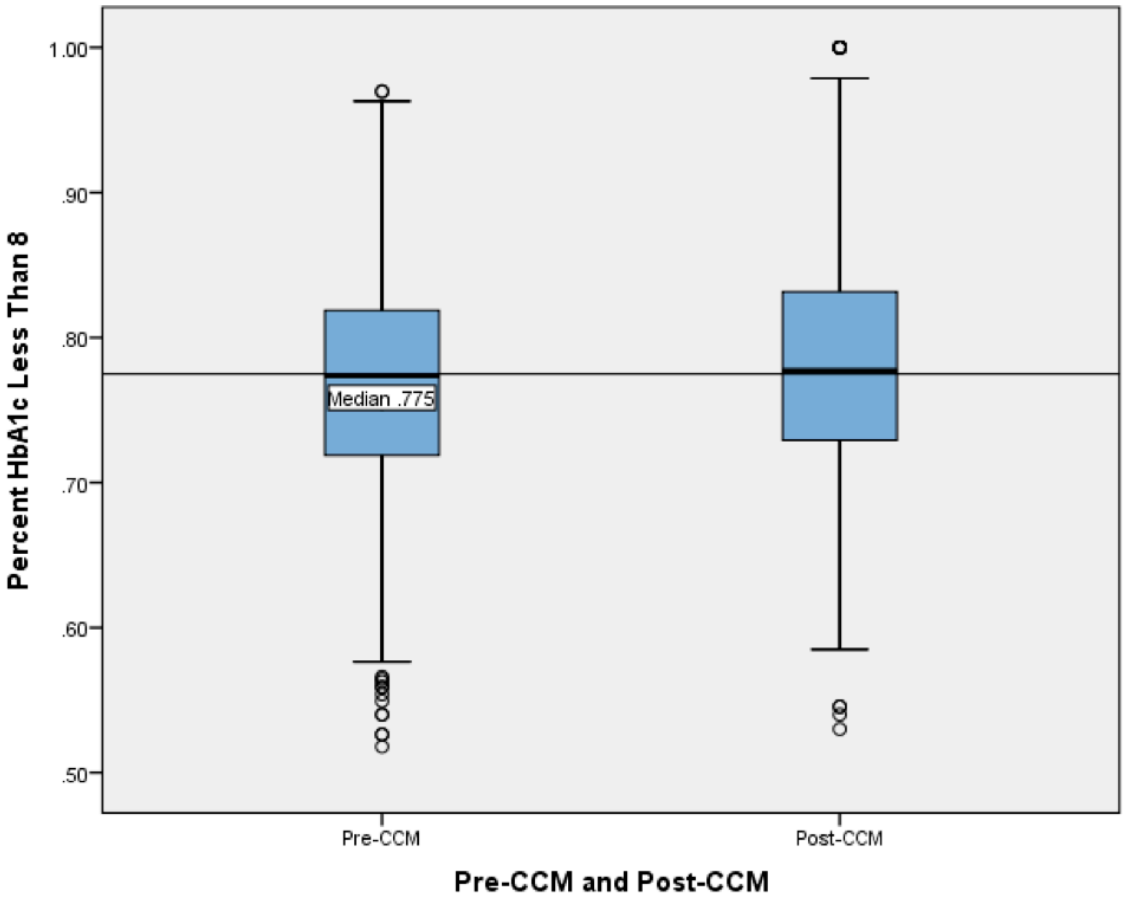

Figure 2. Mood's median test. Box plot showing the percentage of all diabetic patients statewide above and below the median (0.775) for glycemic control (i.e., HbA1c level less than 8%). The pre-CCM group (2013–2014) shows no statistically significant change in the percentage of patients in glycemic control than the post-CCM group (2016–2017).

CHAPTER 5: CONCLUSION

Discussion

The federal courts appointed a Federal Receiver in 2005 to oversee CDCR's health care program, improve health care delivery, and halt avoidable health care related deaths reported in CDCR. In 2006, there were 18 avoidable health care related deaths in the CDCR inmate population. The Federal Receiver and his CCHCS team developed the CCM to address the health care needs of the CDCR prison population. Although two years after the implementation of the CCM, CDCR had zero avoidable health care related deaths (Imai, 2017), the impact of the model for improvement in overall health care for the inmates is not as clear.

As California state prison health care comes into alignment with community standards, the Receiver is delegating health care oversight back to CDCR. As of 2018, roughly half of the institutions' health care services have been delegated back to CDCR. With an annual budget for CCHCS of approximately 3 billion dollars, this expense is higher per patient than any other prison system in the United States (California Government Operations Agency, 2018). As this budget changes hands to CDCR, it is important to assess the effectiveness of the current implementation of the CCM via key indicators of health improvement in order to best care for patients as well as assure a place at the fiscal table to sustain and improve this health care delivery model.

The CCM is a care delivery model grounded in the chronic care theory and evidence-based practice. Worldwide literature on the chronic care theory indicates that comprehensive implementation of all six components of the chronic care theory within a health care program results in improvement in HbA1c scores of

the diabetic patients within the practice (Stellefson et al., 2013). The current study is the first known study to use assessment of statewide HbA1c levels before and after the CCM implementation as a key indicator of efficacy of the CCM for overall health care improvement in CDCR.

This longitudinal retrospective study of the CDCR diabetic population assessed the percentage of diabetics in glycemic control (HbA1c less than 8%) 24 months before and 24 months after the implementation of the CCM in 2015. The year of the implementation process was excluded, as were institutions that were not yet operational during the 24 months before the implementation. The data are publicly available and were assessed from the perspective of the entire diabetic population statewide. The glycemic control of approximately 8,000 diabetic inmates at any given time were reflected in these data sets (J. Dunlap, personal communication, July 29, 2018).

Significance of the Findings

The assessment of the entire CDCR diabetic population shows no statistically significant change in glycemic control post-CCM when compared to the pre-CCM data. Care should be taken in assigning causative factors to the difference in the percentage of CDCR diabetic patients in glycemic control between the pre-CCM and the post-CCM groups from this study. Examples of dynamics which could influence the data outcome include the aging population, prison reforms, the difficult implementation of the EHR in 2015, EHR implementation restarted in 2016, and prison diet. Implementation of the CCM resulted in significant improvement in health care related mortality in this population, as there have been no avoidable health care delivery-related deaths reported since 2012 (Imai, 2017). However, the impact of the CCM on improved

morbidity is inferior to what the literature has indicated in the non-incarcerated population. The lack of improvement in the key indicator assessed in this study, the glycemic control of diabetic patients, suggests there are components of the chronic care theory inadequately adopted in the 2015 CCM implementation (Stellefson et al., 2013), or that there are possibly other confounding factors, special to this population, that are negatively affecting patient health.

While further research and care delivery model development is still needed to attain the potential of chronic-care-theory-based models described in the literature, CCHCS has forward-thinking individuals who support technological improvement and the advancement of the components of the chronic care theory. CCHCS was recognized by the National Association of State Chief Information Officers in 2018 as a finalist for their prestigious State IT Recognition Awards in the category of Digital Government: Government to Citizen. This recognition was given for their work on the interface between the EHR and their real-time key indicator dashboard and disease registries (National Association of State Chief Information Officers, 2018). CCHCS is emerging as a leader in correctional health care.

Study Strengths

A primary strength of this study was the size of the sample. The percentage in glycemic control for the entire CDCR diabetic population is publicly accessible for analysis. This population data included data points relating to approximately 8,000 diabetic patients at any given time during the period of time studied.

Another strength of this study was the use of a known key indicator, HbA1c levels less than 8%, to assess glycemic control. The HbA1c test is well-studied and reliable for assessing glycemic control, having been normed on diabetic

individuals worldwide (Saudek & Brick, 2009). Further, an HbA1c level less than 8% is a glycemic control indicator used as a national standard for health care in the HEDIS measures (NCQA, 2017).

Limitations

A weakness of this study was the permission to only use publicly accessible data between 2013 and 2017. Using aggregated data is excellent for assuring compliance to inmate privacy law; however, these restrictions limit the granularity of permissible study of the sample.

Another potential weakness of this study was changes in the population. There is a constant influx of newly convicted inmates to the population and the loss of others to parole. However, the large size of the sample used minimized the impact of this weakness in the study (Knapp, 2017).

Confounding factors to be considered in this study include the manner of implementation of the CCM across 35 institutions, the aging of the prison population, changes in the dashboard versions, and prison overpopulation. The CCM was implemented by CCHCS with uniform training and consistent CCHCS auditors to assure continuity of the implementation ("The receiver's 29th tri-annual report," 2015). The number of California inmates who are over the age of 50 has increased to 23% from 1990 to 2016; however, the average age of prisoners is still 39.4 years of age (Goss & Hayes, 2018). Any questions regarding the format of the various versions of the dashboard were answered by the CCHCS quality management department. Due to orders by the court to reduce overcrowding in the California prison system, by 2015 CDCR had reduced the population from the peak of 163,000 inmates to 115,000 inmates, which is less than what was mandated by the court (Goss & Hayes, 2018).

Recommendations and Suggestions for Further Study

The assessment of the adoption of the chronic care theory in the CCM showed several areas for further development and research. Assigning patients to panels which consistently align mental health, dental, pharmacy, dietary, nursing, and medical professionals to the same PCT supports the multidisciplinary team component outlined in chronic care theory literature for the development of patient-centered medical homes (Ackroyd & Wexler, 2014). Allowing patients dietary options which align with best practice nutritional therapies (Firth et al., 2015) and self-monitoring of key indicators such as blood sugar encourages self-efficacy in health management (Ball, 2011). Designing decision-support tools for planned care in the electronic record could improve planned care for the patient (Kanter, Lindsay, Bellows, & Chase, 2013). Enhanced use of community services such as weight management resources, healthier prison commissary food options, and exercise programs are examples of programs which broaden the ability of health care providers to address the varied health needs of the population (Baptista, Wiens, Pontarolo, Regis, & Torelli Reis, 2016).

Further research is needed to assess the impact of change in dietary choices both on prisoners' glycemic control and the corrections budget. The work done in Oregon corrections and the Fresh Food Farmacy by Geisinger Hospitals in Pennsylvania both show significant improvement in glycemic control and reduced need for costly diabetic medications for their patients who are offered meals lower in carbohydrates with more non-starchy vegetables (Firth et al., 2015; "Geisinger Health Plan," 2019). The chronic care theory supports evidence-based guidelines, and the strategies being embraced by Oregon corrections and the Geisinger plan align with such guidelines (ADA, 2016a). From a budgetary point of view,

researching this approach to glycemic control is fiscally responsible, since the cost of vegetables is significantly less than the cost of diabetic medications.

Additional research is called for in the area of adding decision support tools into the correctional EHR model. Planned care and decision support tools improve the safety of practice and avoid health care delivery driven by "the tyranny of the urgent" (Bodenheimer et al., 2002). Decision support tools and task reminder systems in the EHR have been shown to improve efficiency and continuity of care in the public sector (Kanter et al., 2013).

The initial use of the chronic care theory in CDCR published by Ha and Robinson in 2009 included preliminary data on the clinician's perspective of the theory use. The authors called for further research and follow up on their work. The Assessment of Chronic Illness Care (ACIC) is a tool which has been tested and validated internationally to assess health care delivery from the care team perspective (Fan et al., 2014). Using an internationally recognized tool to glean the clinician perspectives could both further the work of Ha and Robinson and provide valid data for continual quality improvement regarding the next steps in fully implementing the CCM.

Conclusion

Repeating this study one year after implementing the recommendations above would provide meaningful data to correctional health care providers regarding the efficacy of diabetic patient care based on the tenants of the evidence-based chronic care theory in the prison setting. Nutritional therapy, dietician support, behavioral support, pharmacy support, and exercise are central to planned care of the diabetic patient in prison (ADA, 2014). Dr. Wagner, the author of the chronic care theory states that planned care avoids the "tyranny of the urgent", a

costly approach to medicine which derails focused and preventative care for those with chronic conditions (Coleman, Austin, Branch and Wagner, 2009).

It is essential to leverage the insight gleaned from this and from the research to follow to improve the health care of this vulnerable patient population. It is in alignment with the chronic care theory and it is our civic responsibility to teach these patients to care for themselves. The impact of this study reaches beyond the prison walls and into the community as we prepare today's inmate to be tomorrow's neighbor.

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APPENDICES

APPENDIX A: GLYCEMIC LEVELS DATA TABLES

Table 1

California State Prison Names and Abbreviations

Abbreviation	*Facility Name*
ASP	Avenal State Prison
CAC	California City Correctional Facility
CAL	Calipatria State Prison
CCC	California Correctional Facility
CCI	California Correctional Institution
CCWF	Central California Women's Facility
CEN	Centinela State Prison
CHCF	California Health Care Facility, Stockton
CIM	California Institution for Men
CIW	California Institution for Women
CMC	California Men's Colony
CMF	California Medical Facility
COR	California State Prison, Corcoran
CRC	California Rehabilitation Center
CTF	Correctional Training Facility
CVSP	Chuckawalla Valley State Prison
DVI	Deuel Vocational Institution
FSP	Folsom State Prison
HDSP	High Desert State Prison
ISP	Ironwood State Prison
KVSP	Kern Valley State Prison
LAC	California State Prison, Los Angeles County
MCSP	Mule Creek State Prison
NKSP	North Kern State Prison
PBSP	Pelican Bay State Prison
PVSP	Pleasant Valley State Prison
RJD	R.J. Donovan Correctional Facility at Rock Mountain
SAC	California State Prison, Sacramento
SATF	Substance Abuse Treatment Facility and State Prison, Corcoran
SCC	Sierra Conservation Center
SOL	California State Prison, Solano
SQ	San Quentin State Prison
SVSP	Salinas Valley State Prison
VSP	Valley State Prison
WSP	Wasco State Prison

Note. California City Correctional Facility (CAC) and California Health Care Facility, Stockton (CHCF) were excluded from the study because they could not provide HbA1c data for full timeframe covered by the study.

Table 2

2013 Percentage of Inmates with Diabetes whose HbA1c is Less Than 8%

2013	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
ASP	.86	.86	.85	.84	.84	.82	.83	.84	.83	.88	.86	.86
CAL	.91	.90	.91	.90	.88	.83	.83	.81	.83	.87	.94	.94
CCC	.80	.85	.86	.84	.82	.91	.84	.89	.94	.90	.86	.81
CCI	.82	.80	.81	.84	.81	.78	.77	.78	.77	.73	.76	.78
CCWF	.81	.82	.81	.79	.81	.72	.72	.72	.74	.74	.74	.72
CEN	.77	.76	.74	.78	.78	.83	.80	.80	.78	.82	.82	.84
CIM	.81	.80	.77	.77	.77	.75	.74	.75	.78	.76	.76	.74
CIW	.91	.89	.89	.89	.85	.95	.91	.92	.88	.91	.88	.85
CMC	.87	.86	.87	.87	.86	.83	.81	.82	.80	.78	.79	.80
CMF	.81	.82	.82	.81	.81	.73	.75	.73	.71	.74	.73	.71
COR	.80	.81	.78	.76	.81	.70	.72	.76	.77	.73	.78	.77
CRC	.84	.83	.78	.78	.77	.73	.75	.80	.82	.79	.81	.79
CTF	.77	.78	.78	.79	.79	.78	.77	.78	.78	.74	.72	.72
CVSP	.78	.77	.78	.79	.80	.79	.82	.79	.76	.78	.72	.75
DVI	.71	.71	.72	.78	.78	.92	.88	.92	.91	.86	.85	.85
FSP	.80	.80	.79	.83	.83	.80	.78	.79	.85	.86	.88	.89
HDSP	.79	.80	.80	.82	.80	.70	.68	.65	.63	.62	.63	.62
ISP	.83	.83	.85	.82	.82	.76	.74	.81	.81	.87	.88	.89
KVSP	.80	.81	.78	.75	.78	.72	.71	.74	.76	.75	.75	.70
LAC	.74	.73	.78	.79	.77	.75	.71	.74	.73	.75	.75	.77
MCSP	.84	.83	.84	.84	.84	.77	.76	.75	.74	.74	.78	.80
NKSP	.78	.76	.78	.74	.71	.85	.92	.73	.76	.75	.67	.56
PBSP	.90	.93	.89	.91	.92	.80	.77	.77	.77	.79	.76	.69
PVSP	.79	.81	.80	.78	.78	.62	.65	.73	.74	.64	.62	.60
RJD	.84	.83	.82	.81	.79	.74	.74	.73	.75	.72	.72	.72
SAC	.83	.81	.83	.84	.83	.84	.82	.84	.85	.84	.85	.84
SATF	.81	.80	.82	.80	.82	.78	.79	.77	.78	.77	.76	.78
SCC	.80	.81	.81	.84	.85	.75	.70	.74	.73	.70	.70	.81
SOL	.81	.80	.79	.80	.80	.76	.76	.74	.74	.72	.71	.71
SQ	.73	.74	.76	.76	.75	.73	.74	.73	.73	.70	.70	.67
SVSP	.75	.72	.72	.70	.69	.59	.60	.65	.63	.62	.61	.60
VSP	.80	.80	.80	.82	.80	.81	.82	.81	.81	.80	.80	.84
WSP	.74	.74	.71	.62	.65	.68	.67	.75	.67	.76	.76	.82
SW	.81	.81	.80	.80	.80	.78	.77	.77	.78	.77	.77	.77

Note. Data for 2013 from CCHCS dashboard, listed by month and institution. See Table 1 for explanation of abbreviations. Statewide mean for each month is listed as SW on the final row.

Table 3

2014 Percentage of Inmates with Diabetes whose HbA1c is Less Than 8%

2014	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
ASP	.85	.85	.84	.83	.85	.86	.90	.90	.90	.91	.89	.93
CAL	.94	.89	.91	.90	.83	.74	.67	.67	.64	.68	.73	.71
CCC	.85	.84	.94	.95	.96	.93	.92	.96	.94	.97	.94	.97
CCI	.79	.77	.76	.72	.71	.71	.71	.73	.73	.76	.76	.79
CCWF	.69	.68	.67	.70	.71	.71	.67	.69	.70	.69	.70	.69
CEN	.83	.80	.80	.78	.79	.83	.83	.83	.86	.80	.79	.79
CIM	.75	.73	.72	.71	.72	.73	.75	.76	.77	.78	.78	.80
CIW	.87	.85	.85	.86	.81	.85	.86	.87	.89	.90	.89	.92
CMC	.82	.79	.76	.76	.76	.76	.75	.74	.75	.77	.79	.79
CMF	.71	.70	.72	.71	.72	.69	.66	.66	.68	.70	.70	.69
COR	.75	.73	.71	.68	.69	.70	.71	.71	.67	.67	.67	.64
CRC	.82	.79	.79	.72	.72	.74	.80	.85	.83	.79	.70	.65
CTF	.72	.72	.69	.70	.71	.73	.74	.75	.76	.77	.80	.78
CVSP	.73	.71	.71	.72	.76	.76	.72	.74	.77	.78	.80	.83
DVI	.59	.67	.79	.85	.84	.82	.85	.86	.88	.88	.85	.79
FSP	.83	.83	.79	.75	.75	.73	.73	.75	.74	.79	.80	.83
HDSP	.63	.63	.60	.62	.52	.54	.54	.57	.60	.53	.56	.56
ISP	.83	.82	.77	.81	.79	.78	.83	.82	.81	.84	.86	.87
KVSP	.69	.74	.76	.75	.78	.81	.81	.85	.83	.83	.82	.80
LAC	.72	.71	.70	.69	.67	.67	.68	.62	.63	.63	.62	.58
MCSP	.79	.79	.79	.74	.73	.73	.74	.74	.73	.72	.72	.70
NKSP	.53	.59	.75	.73	.73	.75	.71	.71	.70	.71	.74	.76
PBSP	.68	.67	.70	.72	.86	.80	.81	.83	.86	.92	.92	.96
PVSP	.60	.56	.63	.68	.68	.65	.66	.68	.78	.77	.77	.65
RJD	.72	.70	.70	.70	.72	.71	.70	.71	.69	.70	.72	.72
SAC	.82	.87	.80	.78	.80	.81	.81	.84	.79	.75	.78	.78
SATF	.74	.74	.71	.70	.71	.74	.73	.75	.75	.75	.76	.75
SCC	.78	.77	.79	.81	.81	.82	.80	.78	.77	.76	.79	.81
SOL	.71	.68	.69	.68	.68	.68	.68	.66	.65	.65	.68	.67
SQ	.69	.69	.70	.66	.64	.62	.66	.66	.68	.69	.69	.71
SVSP	.55	.55	.58	.58	.62	.61	.63	.65	.63	.66	.64	.65
VSP	.84	.82	.80	.78	.73	.71	.72	.73	.75	.77	.77	.77
WSP	.86	.83	.76	.84	.83	.89	.89	.82	.94	.81	.83	.75
SW	.75	.74	.75	.75	.75	.75	.75	.75	.76	.76	.77	.76

Note. Data for 2014 from CCHCS dashboard, listed by month and institution. See Table 1 for explanation of abbreviations. Statewide mean for each month is listed as SW on the final row.

Table 4

2016 Percentage of Inmates with Diabetes whose HbA1c is Less Than 8%

2016	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
ASP	0.91	0.91	0.89	0.86	0.89	0.86	0.97	0.97	0.95	0.96	0.98	0.98
CAL	0.77	0.80	0.87	0.82	0.72	0.59	0.53	0.54	0.64	0.63	0.75	0.77
CCC	0.94	0.89	0.89	0.95	0.95	1.00	0.95	0.91	0.90	0.88	0.92	0.85
CCI	0.75	0.75	0.74	0.71	0.70	0.72	0.74	0.75	0.76	0.76	0.73	0.76
CCWF	0.74	0.74	0.74	0.76	0.70	0.72	0.71	0.68	0.66	0.70	0.70	0.74
CEN	0.77	0.76	0.74	0.78	0.78	0.83	0.80	0.80	0.78	0.82	0.82	0.84
CIM	0.82	0.82	0.84	0.81	0.83	0.84	0.83	0.76	0.73	0.75	0.81	0.79
CIW	0.69	0.72	0.71	0.70	0.73	0.73	0.73	0.71	0.72	0.74	0.74	0.72
CMC	0.82	0.80	0.76	0.78	0.80	0.82	0.81	0.82	0.85	0.85	0.82	0.81
CMF	0.89	0.88	0.86	0.85	0.83	0.85	0.83	0.86	0.85	0.88	0.90	0.91
COR	0.79	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.76	0.78	0.80	0.81
CRC	0.65	0.65	0.67	0.66	0.68	0.68	0.68	0.69	0.72	0.73	0.73	0.74
CTF	0.79	0.78	0.77	0.74	0.75	0.73	0.72	0.74	0.81	0.80	0.77	0.77
CVSP	0.83	0.82	0.78	0.80	0.76	0.77	0.75	0.82	0.82	0.83	0.85	0.84
DVI	0.80	0.79	0.76	0.76	0.79	0.78	0.80	0.78	0.79	0.80	0.78	0.77
FSP	0.79	0.77	0.79	0.72	0.66	0.69	0.77	0.77	0.82	0.83	0.82	0.77
HDSP	0.71	0.70	0.66	0.72	0.73	0.76	0.85	0.88	0.93	0.91	0.86	0.82
ISP	0.86	0.85	0.82	0.81	0.86	0.87	0.84	0.83	0.86	0.87	0.84	0.83
KVSP	0.71	0.67	0.65	0.60	0.62	0.63	0.59	0.61	0.60	0.63	0.61	0.60
LAC	0.65	0.62	0.61	0.65	0.61	0.60	0.62	0.66	0.67	0.75	0.78	0.71
MCSP	0.70	0.69	0.62	0.67	0.68	0.69	0.72	0.64	0.68	0.67	0.63	0.65
NKSP	0.70	0.72	0.69	0.68	0.71	0.69	0.70	0.66	0.69	0.68	0.65	0.66
PBSP	0.77	0.75	0.75	0.74	0.74	0.76	0.76	0.78	0.80	0.81	0.79	0.78
PVSP	0.69	0.69	0.75	0.78	0.85	0.73	0.75	0.73	0.76	0.76	0.80	0.81
RJD	0.82	0.75	0.79	0.79	0.86	0.88	0.94	0.93	0.88	0.94	0.94	0.93
SAC	0.94	0.93	0.88	0.93	1.00	1.00	1.00	0.94	1.00	1.00	1.00	1.00
SATF	0.73	0.75	0.74	0.75	0.76	0.76	0.76	0.76	0.79	0.79	0.80	0.80
SCC	0.77	0.77	0.78	0.76	0.78	0.79	0.85	0.87	0.87	0.88	0.88	0.87
SOL	0.74	0.70	0.69	0.68	0.69	0.71	0.70	0.73	0.72	0.72	0.72	0.73
SQ	0.82	0.75	0.76	0.73	0.71	0.73	0.75	0.77	0.72	0.69	0.68	0.71
SVSP	0.67	0.73	0.71	0.69	0.69	0.70	0.72	0.71	0.72	0.72	0.73	0.71
VSP	0.73	0.75	0.74	0.75	0.73	0.73	0.73	0.75	0.75	0.74	0.71	0.70
WSP	0.84	0.83	0.81	0.83	0.82	0.80	0.80	0.79	0.78	0.80	0.83	0.79
SW	0.86	0.83	0.83	0.79	0.81	0.81	0.84	0.85	0.85	0.84	0.83	0.84

Note. Data for 2016 from CCHCS dashboard, listed by month and institution. See Table 1 for explanation of abbreviations. Statewide mean for each month is listed as SW on the final row.

Table 5

2017 Percentage of Inmates with Diabetes whose HbA1c is Less Than 8%

2017	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
ASP	0.96	0.96	0.94	0.95	0.93	0.96	0.93	0.91	0.95	0.91	0.93	0.93
CAL	0.80	0.71	0.68	0.55	0.55	0.65	0.63	0.66	0.70	0.71	0.72	0.78
CCC	0.83	0.83	0.71	0.80	0.81	0.80	0.83	0.90	0.90	0.93	0.97	0.90
CCI	0.76	0.77	0.73	0.70	0.68	0.69	0.71	0.73	0.74	0.74	0.78	0.77
CCWF	0.73	0.72	0.75	0.76	0.78	0.79	0.81	0.82	0.81	0.83	0.82	0.82
CEN	0.79	0.74	0.75	0.75	0.78	0.77	0.76	0.79	0.80	0.82	0.78	0.73
CIM	0.80	0.82	0.81	0.80	0.81	0.83	0.86	0.86	0.88	0.88	0.89	0.85
CIW	0.90	0.84	0.85	0.88	0.89	0.86	0.84	0.85	0.87	0.90	0.89	0.86
CMC	0.81	0.82	0.77	0.76	0.75	0.75	0.74	0.78	0.78	0.78	0.76	0.75
CMF	0.73	0.74	0.75	0.76	0.76	0.76	0.78	0.78	0.78	0.81	0.81	0.79
COR	0.77	0.74	0.76	0.78	0.84	0.86	0.88	0.86	0.89	0.90	0.88	0.88
CRC	0.83	0.79	0.79	0.77	0.77	0.79	0.81	0.85	0.86	0.84	0.81	0.84
CTF	0.76	0.75	0.73	0.75	0.78	0.79	0.81	0.81	0.82	0.83	0.83	0.83
CVSP	0.76	0.79	0.79	0.81	0.77	0.82	0.81	0.80	0.79	0.79	0.79	0.77
DVI	0.82	0.86	0.89	0.85	0.76	0.90	0.89	0.89	0.94	0.95	0.91	0.81
FSP	0.82	0.80	0.81	0.80	0.79	0.79	0.81	0.84	0.84	0.86	0.84	0.83
HDSP	0.61	0.68	0.68	0.74	0.76	0.75	0.77	0.77	0.76	0.76	0.73	0.74
ISP	0.69	0.65	0.65	0.72	0.73	0.72	0.73	0.88	0.92	0.92	0.92	0.88
KVSP	0.65	0.65	0.59	0.60	0.62	0.61	0.58	0.62	0.66	0.70	0.75	0.77
LAC	0.64	0.66	0.67	0.67	0.65	0.67	0.71	0.72	0.72	0.74	0.72	0.72
MCSP	0.77	0.79	0.78	0.78	0.77	0.77	0.80	0.79	0.81	0.79	0.78	0.77
NKSP	0.84	0.81	0.81	0.69	0.75	0.77	0.78	0.77	0.79	0.80	0.80	0.84
PBSP	0.83	0.75	0.80	0.89	0.82	0.77	0.75	0.80	0.82	0.83	0.85	0.71
PVSP	1.00	1.00	0.93	0.92	0.93	0.92	1.00	1.00	0.91	0.88	0.88	0.88
RJD	0.81	0.79	0.77	0.77	0.76	0.75	0.75	0.77	0.77	0.80	0.79	0.78
SAC	0.88	0.83	0.83	0.81	0.80	0.78	0.74	0.76	0.74	0.76	0.76	0.76
SATF	0.73	0.74	0.73	0.71	0.70	0.73	0.76	0.78	0.79	0.78	0.79	0.76
SCC	0.71	0.70	0.69	0.70	0.72	0.82	0.82	0.85	0.87	0.88	0.88	0.89
SOL	0.69	0.70	0.69	0.73	0.75	0.79	0.79	0.83	0.84	0.85	0.83	0.81
SQ	0.70	0.67	0.67	0.67	0.70	0.72	0.73	0.73	0.73	0.74	0.75	0.74
SVSP	0.77	0.78	0.76	0.78	0.79	0.82	0.85	0.84	0.84	0.81	0.80	0.77
VSP	0.86	0.86	0.89	0.86	0.85	0.84	0.83	0.86	0.87	0.89	0.90	0.91
WSP	0.75	0.77	0.73	0.72	0.69	0.66	0.72	0.70	0.73	0.74	0.77	0.72
SW	0.76	0.76	0.75	0.76	0.76	0.77	0.78	0.79	0.80	0.81	0.80	0.79

Note. Data for 2017 from CCHCS dashboard, listed by month and institution. See Table 1 for explanation of abbreviations. Statewide mean for each month is listed as SW on the final row.