Implementation of a Diabetes Treatment Algorithm in Primary Care for Use in the Adult Hispanic Population

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Submitted in Partial Fulfillment of the Requirements for the Northern Arizona University School of Nursing Doctor of Nursing Practice Program

May 8, 2017

Acknowledgements

The completion of this Doctor of Nursing Practice project was made possible with the support of several people. I would like to sincerely thank my Mentor, Dr. Stetina, for her support and guidance throughout this journey. A special thank you to Dr. Reynolds and the Northern Arizona University faculty for their encouragement and inspiration. My very special thanks to my good friend and colleague, Dr. Jennifer Allen. You helped me more than you know and your level head and knowledge kept me focus and grounded. I owe you! To my best friend, colleague, and partner in most things we do in life, Emma Edwards. You know as well as I do that if not for you, I would not have accomplished this amazing feat. Thanks for always being there. To my amazing sons, Luke and Owen, you guys are the greatest kids I could ever ask for, and I can finally say I have no more homework to do! To my family and friends, your love, encouragement, and patience got me through this, and I could not have done this without any of you.

Abstract

Diabetes Mellitus Type 2 (DM2) is a growing problem in the United States. Hispanic Americans have a higher prevalence of diabetes than Non-Hispanic Whites and suffer from more severe complications of the disease. Although advances in diabetes treatment over the last decade has improved, management of diabetes in primary care is inconsistent despite well-publicized guidelines from the American Diabetes Association (ADA) and the American Association of Clinical Endocrinologists (AACE). With the growth of the Hispanic population expected to reach 25 % of the U.S. population by 2050, practice changes must be made to improve diabetes management. The literature supports the use of standardized clinical practice algorithms to provide structure and consistency in clinical decision making and diabetes treatment plans. The purpose of this doctor of nursing practice project was to implement a diabetes treatment algorithm in a primary care community health center for use during patient visits by the primary care provider (PCP) with Hispanic diabetic patients. The participating PCPs were educated on the use of the algorithm and encouraged to utilize the tool at each visit with qualified patients. The tool contains several categories including documentation of an annual foot exam, bi-annual glycated hemoglobin (A1C), A1C number, annual lipid panel, microalbumin, and glomerular filtration rate (GFR), documentation of statin, aspirin, and angiotensin-converting-enzyme inhibitor (ACEI) or an angiotensin II receptor blocker (ARB) use if indicated, titration of medications, documented weight at each visit, and weight management. Chart audits were performed to determine utilization of the tool by pulling data from these categories. During the 30-day study period, 87 patient charts were audited all of which used the algorithm to some degree. Data was analyzed using descriptive statistics and frequency distributions. Of the 87 charts audited, 86 (98.9 %) contained a documented A1C in the treatment algorithm with a mean

A1C of 7.6 percent. Documentation of GFR and aspirin therapy were seen in about half of audited charts. Adherence to recommended annual foot exams, documented microalbumin, and addition or titration of DM medications fell well below 50 %. Weight management through an RD referral was the worst measurement in guideline adherence with only 11 out of 87 patients referred to a dietician. Following the completion of this project, it is evident that adherence to the recommended standards of care is suboptimal in this practice setting. The goal of this practice change project was to improve documentation and guideline adherence through a systems change by implementing a DM treatment algorithm to be utilized by the PCP when treating Hispanic adults with DM2. This process must be sustained and improved upon to close the gap between the national evidence-based recommendations and current clinical practice.

Implementation of a Diabetes Treatment Algorithm in Primary Care for Use in the Hispanic Population

Although advances in diabetes treatment over the last decade have improved, management of diabetes in primary care is poor (Guzek, Guzek, Murphy, Gallacher, & Lesneski, 2009; Maeng, Yan, Graf, & Steele, Jr, 2016). The purpose of this paper is to describe the implementation of a doctorate of nursing practice quality improvement project that introduced a diabetes mellitus type 2 (DM2) treatment algorithm into primary care for use with adult Hispanic patients at a community health center in Phoenix, Arizona. This paper will discuss the intervention design, implementation plan, project outcomes, results, discussion, and implications of these results for healthcare.

Introduction to the Problem

Background Knowledge

The America Diabetes Association (ADA) and the American Association of Endocrinologists (AACE) have well-publicized guidelines and algorithms for the treatment of DM2. The recommendations included are diagnostic and therapeutic actions that are known or believed to favorably affect health outcomes of patients with diabetes (ADA, 2016). These two organizations recommend lifestyle therapy including medically supervised weight loss. Weights should be recorded at every patient visit. The ADA recommends every patient with DM2 meet with a registered dietician for medical nutrition therapy (MNT). Further recommendations include an annual A1C evaluation with a goal of < 6.5 % for patients without concurrent serious illness and at low hypoglycemic risk and > 6.5 % for patients with concurrent serious illness or high risk for hypoglycemia (AACE, 2017). If a patient is at goal, then an A1C should be performed and documented twice yearly. Patients who are not at goal or who have had

medication adjustments should have A1C performed quarterly (ADA, 2016). Medications should be added or titrated every three months until the patient has met an A1C goal. Foot exams should be performed annually, as well as, annual documentation of a fasting lipid panel, microalbumin, and glomerular filtration rate (GFR). Blood pressure should be controlled with a systolic goal of < 140mmHg and a diastolic goal of < 90mmHg. The addition of and angiotensin-converting-enzyme inhibitor (ACEI) or an angiotensin II receptor blocker (ARB) is recommended if goals are not met. In patients less than 40 years old with no cardiovascular disease (CVD) risk, no statin therapy is indicated. However, the ADA (2015) recommends statin therapy for all patients with diabetes age 40 and older regardless of CVD risk. Similarly, aspirin therapy is only recommended for diabetic patients with increased CVD risk which is usually diabetic patients over age 50 with CVD, hypertension, and/or dyslipidemia (ADA, 2015).

Significance

Diabetes Mellitus type 2 (DM2) has increased exponentially over recent years with over 29 million Americans living with DM2 (CDC, 2014). Diabetes Mellitus is especially common among the Hispanic population affecting nearly 13 % of all Hispanic Americans compared to only 7.6 % of non-Hispanic Whites (Centers for Disease Control and Prevention [CDC], 2014). Diabetic retinopathy is 84 % higher in Hispanic Americans versus Caucasian Americans, and end-stage renal disease is 41 % higher among this ethnic minority than their Caucasian counterparts (Congdon, Eldridge, & Truong, 2013). Moreover, Hispanic Americans have limited access to healthcare, increased difficulty controlling symptoms of diabetes, more frequent emergency room visits and hospitalizations, and a higher incidence of diabetes-related complications (Glazier, Bacjar, Kennie, & Willson, 2006; Welch et al., 2011). Many patient-level factors may influence the Hispanic population from receiving DM care such as economic

barriers, work/life demands, low literacy, and cultural and social traditions (Welch, et al., 2011). This topic is especially important as the number of Hispanic Americans in the United States is expected to reach 25 % of the population by 2050 (McKinlay, Piccolo, & Marceau, 2012).

The majority of diabetes morbidity and mortality is due to cardiovascular, and microvascular complications and studies have shown that tighter glucose control does reduce these risks (Welch et al., 2011). The use of a set of standardized clinical practice algorithms provides structure and consistency in clinical decision making and diabetes treatment plans (Welch et al., 2011). The Institute of Medicine (IOM) (2001) supports system redesign to improve chronic disease management through the use of evidence-based practice treatment guidelines through carefully designed decision support algorithms.

The Clinical Problem and Project Purpose

Although advances in diabetes treatment and medications have improved, it is widely recognized that diabetes management by primary care providers is substandard and unwarranted variation in diabetes care remains (Guzek et al., 2009; Maeng, Yan, Graf, & Steele, Jr, 2016). The problem is that although guidelines for the management of DM2 are well publicized, implementation practices are limited and need further improvement. Gaps exist between the national evidence-based recommendations and current clinical practice. This reflects a lack of clinical systems and practice tools to support clinician decision-making, communication, and collaboration (Welch et al., 2011). Improvements in the treatment of diabetes require a change in the care system. An institutional priority in most successful care systems is providing a high quality of care. Changes that have been shown to increase the quality of diabetes care include basing care on evidence-based guidelines; expanding the role of teams to implement more intensive disease management strategies; redesigning the care process; and implementing

electronic health record tools (ADA, 2016). Through informal interviews, direct observation, and chart audit, it was noted that no standardized treatment algorithm or electronic health record tool is utilized in the chosen practice setting to improve the quality of DM care in Hispanic diabetics. Thus, the purpose of this project is to improve documentation and guideline adherence through a systems change by implementing a DM treatment algorithm to be utilized by the PCP when treating Hispanic adults with DM2. This electronic health record tool will serve to base care on evidence-based guidelines.

Clinical Question

Does implementation of a diabetes treatment algorithm by the primary care provider improve adherence to treatment guidelines and improve documentation in the care of Hispanic adults?

Comprehensive Review of the Literature

Define the Search

An exhaustive search of the literature was performed using CINAHL Complete, Medline (Ovid), Cochrane Library, and Google Scholar (including Grey literature) to identify interventions to improve glycated A1C in the Hispanic population. Search strategies differed slightly by database. Keyword combinations include algorithm, treatment algorithm, diabetes management, A1C, Hispanic, and primary care. Articles were selected for review based on if the title, abstract, or text contained any of the keywords or combinations of the keywords. After initial keywords and combinations had yielded results, limiters were applied to all searches that included publishing dates of 2011-2016 and English language.

Databases

CINAHL Complete yielded 29,619 initial results when algorithm alone was searched. Combinations of the keywords A1C then Hispanic generated 209 and 12 results respectively. The limiters of dates, text, and language were applied yielding zero results. The limiters were removed resulting in 12 results of which one article was retained because of its usage of an algorithm to treat chronic disease. With key words of treatment algorithms producing 6,447 articles then combined with diabetes (416) and improved outcomes (30). After limiters had been applied two results were returned, one of which was retained. A1C was searched alone (10,597) and combined with disease management (695) and primary care (169) and after limits applied produced 17 results one of which was kept. Keyword of clinical decision tool was searched (5780) then combined with chronic disease (196) and after limits applied produced 43 results one of which was retained. In Medline (Ovid), key words produced 194,188 results and when combined with the same keywords returned between 3 and 53 results. After limits had been applied, no results were found. Limiters were removed again, but this yield did not reveal any applicable articles; thus, no literature was retained from this search.

Web-based searches

The search of Cochrane Library delivered 5,823 initial results on algorithms alone, combined with diabetic management (295), A1C (35), and Hispanic (20). The limits were applied, but added trials resulted in 64 results of which four studies were kept. Google Scholar had an initial yield of 2,710,000 based on treatment algorithms, combined with diabetes (147,000) and combined with Hispanic (19,900). Full-text and date limits applied returned 14,400 results. This number was further reduced by combining with primary care and improved outcomes to yield 2,780 results. Nine articles were retained from the complete Google Scholar search as these articles directly related to the use of treatment algorithms in a primary care

setting to improve outcomes in the Hispanic population. After completion of the literature search, ten articles were reviewed and retained based on content and strength of the evidence.

Level and strength of evidence

The level of evidence and strength of the research varied significantly. Of the research retained, six results were randomized control trials (RCT), level II evidence. Other studies varied from meta-analysis to expert committee reports, to level III controlled trials without randomization. Also, systematic reviews of RCTs (Level I) were obtained as well as descriptive data (Level VI), qualitative (Level VI), and implementation studies. The systematic reviews that were kept detailed interventions to improve diabetes and management of chronic conditions including the use of algorithms in disadvantaged populations (Glazier, 2006; Shaw, 2014).

Literature Review

Several studies were retained and will be used to guide and support the implementation of a treatment algorithm in the primary care setting in the Hispanic diabetic patient (see Appendix A for evaluation table). Multiple authors used various interventions to improve diabetes outcomes, but the common theme among the studies is the use of a treatment algorithm. Three out of the ten studies incorporated cultural tailoring aspects to the intervention. These studies employed bilingual clinic support staff, diabetes education materials printed in Spanish, and culturally tailored diet plans which improved patient outcomes and overcame barriers that often prevent cultural minorities from receiving healthcare (Fanning, Selwyn, Larme, & DeFronzo, 2004; Glazier et al., 2006; Guzek et al., 2009; Welch et al., 2011). The majority of the studies provided individualized care plans that incorporated diabetes education. Six of the ten studies placed emphasis on behavioral modifications that included exercise, diet modifications, self-blood glucose monitoring, and formulation of care goals which improved LDL, A1C, and

systolic blood pressure (BP) in study subjects. This individualized care is more successful than group treatments or education alone for reaching DM goals (Allen et al., 2011; Welch et al., 2011).

Outcome measures varied across the studies; however, all but one study measured glycated A1C as a primary outcome. Out of the nine studies that did measure A1C, all showed improvement after the intervention. This is important as intensive glucose control reduces microvascular risks associated with DM (Rothman et al., 2005) Other outcome measures included blood pressure, lipids, fasting blood sugar, body mass index (BMI) or weight, treatment adherence, documented eye and foot exams, aspirin use, and diabetes knowledge. In a systematic review by Glazier et al. (2006), 17 randomized-controlled trials (RCTs), controlled trials, and before-and-after studies were reviewed to assess interventions aimed at improving diabetic outcomes in socially disadvantaged populations. The use of a treatment algorithm was identified in six of the 17 studies and was successful in reducing A1C in all six studies ($p<0.0001$). A similar RCT in adult Hispanic patients with poorly controlled DM2 utilized a nurse-led comprehensive diabetes management program (CDMP) which followed a clinical decision-making algorithm to meet evidence-based guidelines in DM care. The results did show improvements in A1C, blood pressure control, and annual eye screening goals but showed no difference in the initiation of aspirin therapy (Welch et al., 2011).

Few studies provided a thorough explanation of the components of the algorithms. Of those that did, components included dietary and exercise consults, medication reviews, documented eye and foot exams, and medication initiation and titration (Mader et al., 2014). Allen et al. (2011) included a detailed treatment algorithm for diabetes, as well as, for cardiovascular disease prevention, and blood pressure management. In this study, 525 patients

with CV disease, DM2, hyperlipidemia, or hypertension were assigned to control or intervention that was delivered by an NP/CHW team using treat-to-target algorithms. The intervention group has improved LDL ($p < 0.0001$), improved systolic BP ($p = 0.018$), and Improved A1C ($p = 0.016$). One algorithm simply focused on preventing complications of DM by ensuring that preventive care such as diabetic foot exams and eye exams were completed annually (see Appendix B for synthesis tables) (Guzek et al., 2009).

Each of the studies employed various healthcare providers or a combination of providers to deliver the intervention. Eight of the ten studies utilized a registered nurse (RN) who had received additional DM training to incorporate the intervention. However, only two of these eight studies allowed the RN to function independently (Ishani et al., 2011; Shaw et al., 2014). The remaining studies integrated the intervention through a collaborative model that included a clinical pharmacist, an advanced practice nurse, a physician, or a combination of these providers. Two studies utilized a lay community health worker who received thorough DM training and a nurse or advanced practice nurse team to deliver the intervention. This combination utilized individualized treatment regimens based on treat-to-target algorithms to improve DM outcomes and improve perceptions of illness (Allen et al., 2011; Glazier et al., 2006). Settings of the interventions varied as did the patient population. Of the ten studies, only three focused primarily on the Hispanic culture (Congdon et al., 2013; Fanning et al., 2004; Welch et al., 2011) whereas the remaining studies included African Americans, Caucasian Americans, Native Americans, Asian Americans, and recent immigrants. The studies focused on low income, low literacy populations where interventions were tailored to specific population needs. Settings varied from both urban and rural medical centers, primary care settings, and community health centers which were the main focus of most studies. The studies varied in the components of the algorithms, the

measured outcomes, the provider who delivers the intervention and the settings. The themes are consistent in the use of an algorithm, no matter the setting, the population, or the interventionist, is useful in achieving desired outcomes specifically improved glycated A1C. Identified gaps in the literature included the fact that many of the studies utilized multiple components to the algorithm making it difficult to determine the exact cause of the result. An additional gap is understanding why implementing treatment guidelines into practice is seldom performed.

Further studies examined provider adherence to guidelines and clinical tools to improve guideline adherence and diabetes care. Diab, Johnson, and Hudson (2012) aimed to design and apply a medication assessment tool (MAT) to determine the level of adherence to internationally recognized guideline recommendations in the treatment of DM2. A 38-criteria MAT was created and utilized to audit charts of 305 patients and found that 68.1 % of charts adhered to guidelines on applicable criteria. The MAT was also able to identify some areas which lacked appropriate documentation of clinical information in patients' records (Diab et al., 2012). In a similar study by Muzaffar, Fatima, Fawwad, and Riaz (2013), a retrospective chart review of patients with DM2 was conducted on 691 patients to evaluate evidence of documentation of testing and treatment. Deficiencies were observed in most areas of diabetes care. HbA1c and lipid profile were noted in 44.57% and 40.08% of the patients respectively. Foot exams were documented in 44 % of patients' records, while 30.53 % had funduscopic eye exams noted. Study findings showed that most of the medical records of patients were inadequately filled, lacked proper documentation, and adherence to ADA guidelines was suboptimal (Muzaffar et al., 2013). A study by Pruthu et al. (2015) performed retrospective chart audits of 156 patients with DM2. Care processes were considered optimal went patients had undergone BP measurement at every visit, blood sugars documented monthly or every three months based on medication treatment,

lipid and renal profiles every six months, annual eye exams, and annual electrocardiographic monitoring. After these care processes were audited and notated as poor, the practicing providers were made aware of these results and given an orientation to the current standard practicing guidelines. One year later the chart audit was repeated which showed an improvement in BP measurement by 35 %, blood glucose monitoring by 20 %, lipid profiles by 36 %, and renal profiles by 56 %. The results did show an improvement in guideline adherence through utilization of a clinical audit cycle tool (Pruthu et al., 2015). These research studies support the methods of this project in examining the providers' roles in guideline adherence.

Conceptual and Theoretical Frameworks

The literature review studies included concepts of different theories and models to design and execute a project. For the development of the project idea of implementing algorithms to improve diabetes care among Hispanic patients Lewin's change theory model will be applied (see Appendix C). Kurt Lewin's change theory has three major forces that include driving forces, restraining forces, and equilibrium (Butts & Rich, 2015). His theory includes three steps for unfreezing, moving, and refreezing. Unfreezing means unlearning old behaviors that were ineffective. The moving stage is where the change process of new thoughts, behaviors, or actions occur. Then the refreezing stage establishes the change as a new habit and equilibrium is restored (Butts & Rich, 2015). To successfully institute and utilize a treatment algorithm to manage diabetes in Hispanic patients in a primary care setting, providers and staff must unlearn past behaviors. This means prior treatments that followed no guidelines should be unlearned so that new change can take place. Providers must unfreeze the status quo of misaligned practices with national guideline standards. Then movement towards change is in the form of a

standardized DM treatment algorithm. Once the algorithm is implemented, it must be used every visit on every patient. Then this change should be refrozen as the new way of practice.

Project Implementation and Methodology

The DNP project was determined to be exempt after review by the institutional review board (IRB) at Northern Arizona University (See Appendix D). With approval from the clinical site (see Appendix E), the implementation of the DM treatment algorithm took place in a community health center (CHC) in Phoenix that provides primary care to the underserved and underprivileged. It was here that observations were made that no clinical tool was utilized to promote guideline adherence in the treatment of DM among vulnerable populations such as Hispanic patients. Internal evidence shows 72 % of patients at this clinic identify as Hispanic/Latino. Thus, the idea to implement a DM treatment algorithm to utilize during visits with Hispanic patients was formed.

The algorithm was created through collaboration with provider champions based on ADA guidelines with categories for annual foot exam and eye exam, referrals to integrated services such as a clinical pharmacist (CP), behavioral health consultant (BH), and a registered dietician (RD), laboratory values, medications, and BP and weight measurements (see Appendix F). For the purpose of this algorithm, the criteria includes: foot exam documented once yearly, A1C documented twice per year if at goal and every three months if not at goal, lipid panel, microalbumin, and GFR once yearly, statin therapy if the patient is at increased CVD risk and/or LDL > 100 mg/dL, aspirin therapy if the patient is at increased CVD risk, > 50 years old, has hypertension, is a smoker, or has dyslipidemia, use of an ACEI or an ARB if the patient has hypertension defined as systolic BP > 140 or diastolic > 90 mmHg or microalbuminuria. Per ADA guidelines and for measurement criteria for this project, diabetes medications should be

added or titrated every three months until the patient is at goal A1C (ADA, 2016). Weight should be documented at every patient visit and patients with a body mass index (BMI) greater than 25 % require referral to an RD. In collaboration with the electronic health record (EHR) champions, the algorithm was placed into the EHR and accessed through the patients' charts. This algorithm is easily accessible to providers with expected outcomes of use to include improved adherence to national guidelines, decreased variability in treatment, and improved provider documentation. A convenience sampling of four family practice providers within the health clinic was utilized. The participants include two Medical Doctors (MD), one Doctor of Osteopathic Medicine (DO), and one Family Nurse Practitioner (FNP). Inclusion criteria are providers who specialize in family practice, who treat adult patients, and who are full-time employees. As the focus of this project is on evaluation of the algorithm in Hispanic diabetic patients, audits were performed on charts that met the conditions of Hispanic adults 18 years of age or older with a diagnosis of diabetes type 2 (DM2). Prior to implementation, the participating providers were educated on the use of the algorithm through a PowerPoint presentation. No additional costs were incurred for project implementation as the algorithm utilization is done at regular patient visits during regular business hours. The creation of the algorithm and its addition to the EMR incurred no cost. The training on the use of the algorithm occurred at a regularly scheduled provider meeting, and any additional, individual assistance or training took place throughout the work day. Thus, any indirect costs were absorbed by the project site.

The clinical site supported this project in its entirety as the agency fosters an environment of learning and practices evidence-based care. Additional support came from the stakeholders and the medical director of the organization. Resources included an established EHR with the capabilities of adding an algorithm, willing participants, and support staff. Barriers to the project

involved time constraints as providers generally see 20 to 26 patients per day and an additional step in care can seem inconvenient to a busy provider. Also, providers are often resistant to change which can be challenging to overcome.

A chart audit tool was created to organize collected data (see Appendix G). The chart audit form contains the DM ICD-10 code, documentation of an annual foot exam, bi-annual A1C, A1C number, annual lipid panel, microalbumin, and glomerular filtration rate (GFR), documentation of statin, aspirin, and ACEI/ARB use if indicated, titration of medications, documented weight at each visit, and weight management. The chart audit form received face validity from practicing providers. The data collection measures are based on the American Diabetes Association (ADA) standards of care guidelines (2016) to assess appropriate care in diabetes management.

The treatment algorithm was implemented into practice on December 23, 2016. The data was collected over a 30-day period following implementation of the clinical decision support tool to promote system change. Qualified patient data was pulled from the electronic algorithm and input into the chart audit tool and answered as yes, no, not applicable, or with a number value. The timeline of the entire project from initiation, planning, and implementation to completion took place from the fall of 2015 to spring of 2017 (see Appendix H).

Evaluation and Data Analysis

A total of 885 patient charts were reviewed, 87 of which met criteria. The Hispanic descent was determined by patient self-identification in the patient demographics section of the chart. The data collected from these 87 charts were input in the audit form then uploaded into the statistical package for the social sciences (SPSS) version 24 software. Descriptive statistics were used to describe the provider sample (see Appendix I). Frequency distributions were examined

for each category of the chart audit form to measure usage of the tool and appropriate care and documentation per guidelines. Frequencies were determined for each criterion, and then a percentage score was calculated. A mean A1C was calculated, and average patient age was reported. This evaluation plan was appropriate for the project as it is an outcome-based evaluation of a system change process, which includes a retrospective chart audit to measure usage of the algorithm tool and adherence to treatment guidelines.

Results

The mean patient age of the 87 audited charts was 54.8. Of the 87 charts audited, 86 (98.9 %) contained a documented A1C in the treatment algorithm with a mean A1C of 7.6 %. Thirty (34.5 %) charts documented an annual foot exam. Lipid panels were documented in 67 (77 %) of the 87 charts, microalbumin values were documented in 31 charts (35.6 %), and GFR was documented in 44 (50.6 %) charts within the treatment algorithm. Documented use of a statin was noted in 61 (70.1 %) of the 87 charts, 8 (9.2 %) did not document a statin when it was appropriate, and 18 (20.7 %) charts were not applicable for statin use. Appropriate use of aspirin therapy was documented in 50 charts (57.5 %), 15 (17.2 %) charts did not accurately document aspirin use, and aspirin use was not indicated in 22 charts (25.3 %). ACEI/ARB use was properly documented in 63 (72.4 %) of reviewed charts, 5 (5.7 %) charts had no documentation of ACEI/ARB use when it was indicated, and 19 (21.8 %) had no indication for the use of an ACEI/ARB. Addition of or titration of diabetic medications was documented in the algorithm of 33 (37.9 %) reviewed charts, 10 (11.5 %) charts did not document additions or adjustments of medication when it was appropriate based on guidelines, and 44 (50.6 %) charts had no indication for medication changes. Patient weight was documented in the algorithm in 85 (97.7 %) of the 87 audited charts, but only 11 charts documented a referral to the registered dietician

(RD) for weight management. Seventy-four percent should have had weight management counseling while another 12.6 percent did not meet criteria that required weight management counseling. Counts and percentages are shown in Appendix J.

Discussion, Recommendations, and Conclusion

All 87 charts utilized the treatment algorithm to some degree. Compliance was highest among A1C documentation and lipid panels, weight measurements, and statin and ACEI/ARB therapies. Documentation of GFR and aspirin therapy were seen in about half of audited charts. Adherence to recommended annual foot exams, documented microalbumin, and addition or titration of DM medications fell well below 50 %. Weight management through an RD referral was the worst measurement in guideline adherence with only 11 out of 87 patients referred to a dietician. Following the completion of this project, it is evident that adherence to the recommended standards of care is suboptimal in this practice setting. The ADA recommends these screenings and therapies for all diabetic patients, however, an analysis by researchers at the CDC suggest that < 5 % of diabetic patients receive care that conforms to the ADA guidelines (CDC, 2015). Although, patient reports from the state of Arizona found that 72.5 % of surveyed patients reported receiving an annual foot exam and 67.3 % reported having their A1C checked at least twice per year (CDC, 2015).

This algorithm serves to align with the recommended treatments for DM and to follow the algorithm will improve guideline adherence, thus improving care delivered to diabetic patients. The project goals align with goals established by Healthy People 2020 to decrease the burden of DM through redesign of healthcare systems and delivery (Office of Disease Prevention and Health Promotion, 2017). The project is sustainable as the algorithm is a practice change that is easy to comply with through the use of the EHR. This projected change will impact the local

community by improving diabetes management within the Hispanic population, thereby reducing complications of the disease, hospitalizations, and healthcare costs. This improvement may also increase patient satisfaction thereby improving the reputation of the facility which may increase the patient panel. The community health center will further benefit by achieving improved quality measures, supporting patient-centered medical home concepts, and increase revenue through pay for performance initiatives. Recommendations for this practice change will be implemented within all five offices of the community health center in the Phoenix area and expand to include all diabetic patients thus, providing high quality, efficient, and cost-effective care to more patients. The algorithm serves the provider as an easy reminder of recommended therapies and screenings. Future studies should include measurement of patient outcomes such as A1C and follow-up chart audit in the future could prove useful. The addition of a post-implementation provider satisfaction survey is a recommended consideration that may provide valuable information into the tool and provide a guide for future improvements.

Several limitations were recognized during this project with key lessons identified. First, it was discovered that some of the criteria could be found in the patient note, but this data was not carried over to the algorithm. In most cases, this was likely a glitch in the EHR. At times, this was human error as it was noted that some patients actually were referred to or seen by an RD but the provider neglected to input this into the algorithm. Occasionally, patient compliance or adherence was noted as a problem. For example, when searching through a patient record, lipid panels, microalbumin, and GFR may have been ordered, but the patient did not complete the tests. Therefore, the information was not transferred to the algorithm. Finally, some patients were new to the practice or newly diagnosed diabetics. Hence, past results were not available, and medications could not be titrated. Some key lessons learned included use of previously

established patients with a diagnosis of DM II for greater than one year would have better served this project. But most importantly, the success of this practice change is dependent on providers' acceptance of a practice change, understanding of collaboration, and willingness to work towards common goals.

In conclusion, a diabetic treatment algorithm is a simple tool to promote practice change to improve adherence to diabetic treatment recommendations which, in turn, improves patient outcomes. As the majority of individuals with diabetes in the U.S. receive care for the condition from primary care physicians (CDC, 2015) it is important that providers are given tools such as an EHR DM treatment algorithm to guide care, minimize variability, and adhere to national guidelines. During their lifetimes, half of all Hispanic people will develop DMII (CDC, 2015) making the need for quality DM care imperative among this population. The goal of this practice change project was to improve documentation and guideline adherence through a systems change by implementing a DM treatment algorithm to be utilized by the PCP when treating Hispanic adults with DM2. This process must be sustained and improved upon to close the gap between the national evidence-based recommendations and current clinical practice.

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Appendix A

Evaluation Tables

Table 1

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
1) Glazier, R., Bajcar, J., Kennie, N., & Willson, K. (2006) *A systematic review of interventions to improve diabetes care in socially disadvantaged populations*	None stated Health promotion Behavioral change model principles implied	Systematic review 17 studies included 10 RCT 5 CS 2 PCS Inclusion Criteria: 1)Targeted interventions for disadvantaged adults with DM 2)RCTs, controlled, or before/after studies with comtemporaneous control group 3)Includes measures of patient, provider, or system outcomes	N= 17 n= 3979 A=35-70 G=M/F R=varies, AA, MA,NA, Asian, Cauc, Ed= predominantly low SES, low literacy, < 12 graded Settings: CHC, PC, Inner city, Rural	**IV=** SBGM, diet, exercise, scheduled appts, diagnosis, prescribing, educational material, counseling, referrals, followed algorithms, clinical outcomes **IV2=** Control groups **DV1=** A1C **DV2=** BP **DV3=** Weight **DV4=** BMI **DV5=** Lipids	A1C levels, Serum lipids, BP, BMI, DM-related knowledge, FBG, DRS (Gary, 2003) PAI, TIPS (Clancy, et al., 2003) PCAT,	Data analyzed based on 5 categories: Intervention target, intervention design, setting, delivery of intervention, intensity and duration of intervention. Reviewers used analytical approach to determine statistically and clinically significant outcomes	1)Treatment algorithm groups had greater reduction in A1C ($p<0.0001$) 2)Improvement in activity, nutrition, and lipids in first 3 months but declined after 6 months 3)No significant change in BMI Finding of interest= All but one study showed improved A1C level after intervention	**Level of Evidence:** Level I **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Use of RCTs **Weaknesses:** Multiple components to interventions cannot clearly identify which intervention was most effective; Small number of studies; Heterogeneity; varying interventions; short-term duration; **Conclusions:** Identified features of interventions to improve DM in disadvantaged populations included culturally tailored education, one-on-one intervention, and incorporating treatment algorithms

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
2) Shaw, R., McDuffie, J., Hendrix, C., Edie, A., Lindsey-Davis, L., Nagi, A.... & Williams Jr., J. (2014) *Effects of nurse-managed protocols in the outpatient management of adults with chronic conditions*	None stated Chronic care model principles implied	Systematic review and meta-analysis 16 RCTs 2 Controlled before and after Inclusion Criteria: 1)Involvement of RN functioning beyond usual scope 2)Use of treatment protocol	N=17 n= 23,004 A= median 53.3 years G= M/F R= Not reported Ed= Not reported Settings: General medical hospital, Specialty hospital, PC	**IV=** Nurse led treatment protocol Medication education Self-management plan **IV2=** Control group **DV1=** Glucose **DV2=** A1C **DV3=** Lipids **DV4=** BP **DV5=** Behavior adherence **DV6=** Protocol adherence	A1C levels, Serum lipids, BP, Patient adherence to treatment (scale not discussed), Adherence to protocols (scale not discussed), Adverse effects (scale not discussed), Resource use (scale not discussed)	A1C measured in % BP measured in mmHg Total cholesterol measured in mmol/L	1)Nurse-managed protocols decreased A1C 0.4% (95% CI) 2)Decreased systolic BP by 3.68 mmHg (CI, 1.05 to -6.31 mmHg) and diastolic BP by 1.56 mmHg (CI, 0.36 to 2.76 mmHg) 3)Decreased total cholesterol by 0.24 mmol/L (CI, 0.54 mmol/L decrease to 0.05 mmol/L increase) 4)Improved behavior adherence (P= 0.03) 5)When compared with usual care group, nurses followed protocol and initiated lipid lowering medication more often and doses of other medications were titrated more often 6)Adverse effects reported in one study of increase from 1.5% to 2.9 % occurrence of severely low blood glucose (P=0.158) 7)Resource use reported in 3 studies found lower salary costs and lower medication costs	**Level of Evidence:** Level I **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Protocol intervention had consistently positive effect on chronically ill patients Duration of study 12 months for 8 studies and <12 months for 8 studies **Weaknesses:** Limited description of interventions and protocols Most studies showed moderate risk of bias Two studies were high risk for bias due to inadequate randomization **Conclusion:** This systematic review and meta-analysis found that use of nurse-managed treatment protocols may have positive effects on the outpatient management of adults with chronic illness such as DM, hypertension, and dyslipidemia

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
3) Ishani, A., Greer, N., Taylor, B., Kubes, L., Cole, P., Atwood, M.... & Ercan-Fang, N. (2011) *Effect of nurse case management compared with usual care on controlling cardiovascular risk factors in patients with diabetes*	None stated Health promotion and ICCM principles implied	RCT Trial of diabetic patients with BP >140/90, A1C >9.0%, or LDL >100 mg/dl received case management versus usual care over 1-year period. Case management consisted of patient collaborating with a nurse who established lifestyle modification, action plans, and medication adjustments based on established protocols.	N= 556 A= Mean 65.4 G= M 98.6% R= AA 12.5% Cauc 93.2% Other 1.6% Ed= Not reported Settings: MVAHCS	**IV1=** Case management N= 278 **IV2=** Usual care N=278 **DV1=** BP < 130/80mm/Hg and LDL < 100 mm/Hg and A1C < 8.0 % **DV2=** % of patients meeting individual treatment goals	% of patients meeting DV1. Results measured by usual standards	Two-sided Pearson X2 test and ANOVA	DV1= BP < 130/80mm/Hg and LDL < 100 mm/Hg and A1C < 8.0 % IV1= 21.9 % (P= <0.001) IV2= 10.1 % (P=0.047) Secondary outcomes: Individual without all 3 above criteria met: A1C < 8.0 % with baseline > 9.0 % = IV1= 40.5 % IV2= 24.6 % LDL < 100 mg/dL with baseline LDL > 100mg/dL= IV1= 40.9 % IV2= 27.7 % BP < 130/80 mmHg with baseline BP >140/90 mmHg= IV1= 40.6 % IV2= 15.9 %	**Level of Evidence:** Level II **USPSTF grading schema:** Grade: Quality of Evidence: **Strengths:** Large sample size with minimal exclusion criteria Generalizable Study detected differences in achieving 3 CV risk factors as opposed to one which increased acceptability by patients **Weaknesses:** Inappropriate randomization of patients that did not meet criteria but were later excluded Multiple components to interventions cannot clearly identify which intervention was most effective **Conclusion:** In patients with diabetes, nurse case managers using a treatment algorithm can effectively improve the number of individuals with control of A1C, LDL, and BP at 1 year

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
4) Mader, J., Neubauer, K., Schaupp, L., Augustin, T., Beck, P., Spat, S.... & Plank, J. (2014) *Efficacy, usability and sequence of operations of a work-flow integrated algorithm for basal-bolus insulin therapy in hospitalized type 2 diabetes patients*	None stated	Ward-controlled study 74 DM type 2 patients were assigned to either algorithm-based treatment with basal-bolus insulin therapy or to standard glycemic management Aim was to assess the efficacy, workflow, and usability of an algorithm in hospitalized patients with DM type 2	N= 74 A= Mean 68 G= F 24 BMI= 30 +/- 7 R= not reported Setting: Two medical units at Medical Center in Austria	**IV1=** Algorithm group N= 37 **IV2=** Usual care N=37 **DV1=** BGL **DV2=** Physician adherence to the algorithm-calculated TDD	Glycemic control measured by point of care testing four times daily and continuous BGL monitoring for algorithm group Compliance of physician adherence was documented and any deviation recorded to measure noncompliance Questionnaire completed at the end of study to assess efficacy and usability	One-tailed matched pairs t-test with 2.5 % level of significance, power of 80 % and a correlation between paired measurements (Beginning and end of treatment) Pearson's chi-squared tests used to analyze nominal data	DV1= BGL decreased from 11.3 mmol/L to 8.2 mmol/L in IV1 group DV2= 95 % physician adherence to the algorithm TDD	**Level of Evidence:** Level III **USPSTF grading schema:** Grade: Quality of Evidence: **Strengths:** High level of staff adherence Improved glycemic control **Weaknesses:** Study lengths varied dependent on length of hospitalization but all concluded at 21 days or at discharge Not randomized **Conclusion:** The workflow integrated algorithm for basal-bolus therapy was effective in attaining glycemic control and found to be usable and effective by staff

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
5) Rothman, R., Malone, R., Bryant, B., Shintani, A., Crigler, B., Dewalt, D.... & Pignone, M. (2005) *A randomized trial of a primary care-based disease management program to improve cardiovascular risk factors*	None stated Patient-centered innovation principles applied	RCT Intervention patients received intensive management form clinical pharmacists and diabetes care coordinators who provided diabetes education, applied algorithms for managing glucose control and decreasing CV risk factors over 6 and 12 month period	N=217 G=M/F F=122 A=55mean R=AA 140 Other races not discussed Ed= HS or less 159 Inclusion criteria= patients >18 with A1C >8.0 % Setting: University of North Carolina General Internal Medicine Practice	**IV1=** Intervention group N= 112 **IV2=** Usual care N= 105 **DV1=** BP **DV2=** A1C **DV3=** Lipids **DV4=** ASA use **DV5=** Improved knowledge and treatment satisfaction	BP measured by clinic nurses using automated machines A1C measured at hospital lab using automated analyzer TC, HDL, and LDL measured at hospital lab using automated analyzer Diabetes knowledge and satisfaction used DTSQ (Bradley, 1994)	ANOVA t-tests Analysis of covariates	Systolic BP for IV1= Decreased by 7 mmHg (95 % CI, P= 0.008) Diastolic BP for IV1= Decrease of 4 mmHg (95 % CI, P= 0.02) A1C for IV1= Decrease by 2.5 % (95 % CI, P= 0.05) TC for IV1= Not significant ASA use 91 % in IV1 (P<0.0001) DM knowledge in IV1 increased + 27 from baseline to 12 months compared to IV2= +12 DM treatment satisfaction in IV1 increased +8 from baseline to 12 months compared to IV2= +4	**Level of Evidence:** Level II **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Improved outcomes utilizing intervention Mainly minority population Large sample size 12-month duration **Weaknesses:** Baseline differences between groups despite randomization Conducted at single facility with poor follow-up limiting generalizability Some measures based on self-report and may have bias **Conclusion:** Intensive DM management led by pharmacist and DM care coordinator who followed treatment algorithms did improve DM outcomes

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
6) Allen, J., Dennison-Himmelfarb, C., Szanton, S., Bone, L., Hill, M., Lewis-Boyer, L.... & Anderson, K. (2011) *A randomized, controlled trial of nurse practitioner/community health worker cardiovascular disease risk reduction in urban community health centers*	CPBR	RCT 525 patients with CV disease, DM2, hyperlipidemia, or hypertension were assigned to control or intervention that was delivered by an NP/CHW team using treat-to-target algorithms	N=525 G=M/F F=374 A=54 mean R=AA 417 Non-AA 108 Ed= HS or less 380 Inclusion criteria= patients >21 with diagnosis of CVD, hypertension, or DM2 receiving therapy Setting: Two community health centers in Baltimore	**IV1=** Intervention group N= 261 **IV2=** Usual care N= 264 **DV1=** BP **DV2=** A1C **DV3=** Lipids **DV4=** Patient perception of the quality of their chronic illness care	BP measured using digital cuff according to JNC VII guidelines A1C measured using high-pressure liquid chromatography Lipids measured at Johns Hopkins University lab PACIC (Glascow, 2005)used for DV4	t-test x2 test	IV1 = Improved LDL (75 % versus 58% in IV2, P=<0.001) IV1= Improved systolic BP (82% versus 74 % in IV2,P= 0.018) IV1= Improved A1C (60% versus 47 % in IV2, P= 0.016) IV1= Improved patients' assessment of their chronic illness care	**Level of Evidence:** Level II **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Improved outcomes utilizing intervention 94 % of participants completed 1-year assessment Large sample size 12-month duration **Weaknesses:** Predominately female and AA lessening generalizability Conducted in one setting Physicians had patients in both groups which may have influenced care in the non-intervention group **Conclusion:** Use of treat-to-target algorithms led by NP/CHW can be effective to improve risk factors status and perceptions of illness care in high-risk patients

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
7) Welch, G., Allen, N., Zagarins, S., Stamp, K., Bursell, S., & Kedziora, R. (2011) *Comprehensive diabetes management program for poorly controlled Hispanic type 2 Patients at a community health center*	CCM ICCM	RCT An RCT in adult Hispanic patients with poorly controlled DM2 utilized a nurse-led CDMP which followed a clinical decision-making algorithm to meet evidence-based guidelines in DM care (lower A1C, BP, DM distress, and increase adherence to annual foot and eye exams and increase aspirin use)	N= 39 G=M/F F= 65 % A= 56 mean R= MA Ed= >HS 40.2 % Inclusion criteria= Age 30-85 DM2 diagnosis > 1 year A1C >7.5% Hispanic ethnicity Setting: Urban CHC in Springfield, MA	**IV1=** Intervention group (IC) N= 25 **IV2=** Attention control condition (AC) N= 21 **DV1=** A1C **DV2=** DM Distress **DV3=** Systolic BP **DV4=** Eye screening **DV5=** Foot screening	A1C measurement method not discussed BP measured with an aneroid BP monitor after 5-minute rest period Eye screening and use of ASA obtained from self-report questionnaire PAID scale (Welsh, 1997) used to measure DM specific emotional distress	ANOVA Chi-square Fisher exact Paired t tests	IV1 = 45 % met goal (A1C <7.0 %) compared to IV2 28 % (P=0.27) IV1= 55 % met BP goal (<130/80) compared to IV2 28 % (P= 0.09) IV1= 65 % met criteria for low DM distress compared to IV2 33 % (P= 0.05) IV1= 95 % met annual eye screening goal compared to IV2 78 % (P= 0.27) IV1= 100 % ASA adherence IV2= 100 % ASA adherence	**Level of Evidence:** Level II **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Improved outcomes utilizing intervention Use of nurse-led clinical decision-making algorithm Included strong cultural sensitivity component High participation rate of providers 12-month length of study Detailed intervention described **Weaknesses:** Small sample size Possible contamination the educators from the intervention group trained and supervised the AC staff **Conclusion:** Use of the CDMP model was effective in helping patients meet evidence-based guidelines for DM care

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
8) Fanning, E., Selwyn, B., Larme, A., & DeFronzo, R. (2004) *Improving efficacy of diabetes management using treatment algorithms in a mainly Hispanic population*	Not stated CCM and ICCM principles implied	Observational group comparison Treatment intervention for DM2 was implemented to evaluate the effectiveness of treatment algorithms versus standard care in improving glycemic control and CV risk factors in low-income, DM2 MA Participants divided into 3 groups: CC-TA UC-TA CC-SC	N= 358 G=M/F F= 66 % A= 46 mean R= 90 % MA Other races not discussed Ed= average completed grade level= 9th Inclusion criteria= DM diagnosis within 1 year Never have taken insulin, lipid-lowering or antihypertensive medication, and no oral agents used within 6 months No retinopathy and normal serum creatinine Setting: Three CHC in San Antonio, TX	**IV1=** CC-TA N=106 **IV2=** UC-TA N= 170 **IV3=** CC-SC N= 82 **DV1= Primary outcome:** A1C **DV2=** FBG **DV3=** Lipids **DV4=** Eye screening **DV5=** Foot screening	A1C analyzed by Cobas Integra Glucose HK Liquid Diagnostic Reagent System Plasma glucose analyzed by Glucose Oxidase Analyzer TC, HDL, and triglycerides analyzed by Cobas Integra Direct Reagent System Eye screening/Foot screening from chart review	ANOVA	CC-TA = 49 % of patients achieved A1C of <7.0 % Patients with elevated TC, LDL, triglycerides and reduced HDL= 35 % Eye and foot exams = 90 % UC-TA = 51 % of patients achieved A1C of <7.0 % Patients with elevated TC, LDL, triglycerides and reduced HDL= 55 % Eye and foot exams = 83 % CC-SC= 26 % of patients achieved A1C of <7.0 % Patients with elevated TC, LDL, triglycerides and reduced HDL= 69 % Eye and foot exams = 60 % No statistical significance in systolic BP among all 3 groups	**Level of Evidence:** Level IV **USPSTF grading schema:** Grade: B Quality of Evidence: Good **Strengths:** Large sample size Inclusion of detailed algorithm Barriers to treatment discussed **Weaknesses:** Not randomized Non-compliance of patients observed in all 3 groups **Conclusion:** Adherence to treatment algorithms in newly diagnosed DM2 patients is more effective to achieve blood glucose and lipid control than usual care

Author and Title	**Conceptual Framework**	**Design/Method**	**Sample/ Setting**	**Major Variables Studied**	**Measurement of Major Variables**	**Data Analysis**	**Study Findings**	**Level & Quality of Evidence. Study Strengths and Weaknesses**
9) Guzek, J., Guzek, A., Murphy, K., Gallacher, P., & Lesneski, C. (2009) *Improving diabetes care using a multitiered quality improvement model*	Not stated Process improvement principles implied	Quality improvement process study Objective was to increase annual rate of recommended tests and exams for patients with DM and to reduce A1C, BP, and LDL through protocol-driven electronic prompts for clinicians which included built-in clinical decision tools	N= 1592 No other patient characteristics stated Inclusion criteria: All active patients in electronic database > 18 years old with DM diagnosis Setting: Medium-sized community group practice in WI with 12 clinicians	No control group Process improvement implementation applied to all included patients	Process measures: Measurement of: A1C in prior 6 months BP in prior 6 months LDL in prior 12 months HDL in prior 12 months Triglycerides in prior 12 months Urinary microalbumin in prior 12 months Performance of eye exam and foot exam in prior 12 months Outcomes measures: Most recent A1C < 7.0 % BP < 130/80 mmHg LDL < 100 mg/dL HDL > 45 mg/dL	12 study indicators; For each study indicator, the proportion corresponded to the % of DM patients who met the target Summary measure DSI (Guzek, et al., 2016) reflected the average % of the 12 targets met by patients	Average DSI at baseline was 61.2 % After 12 months of utilizing process improvement methods, DSI increased to 70.1 % Statistically significant improvement for 5 of 8 process measures and for 2 outcome measures	**Level of Evidence:** Level IV **USPSTF grading schema:** Grade: C Quality of Evidence: Fair **Strengths:** 12 study indicators identified with overall improvement in majority Clinician buy-in Clinician feedback provided **Weaknesses:** Not RCT Protocols and built-in electronic tools not well described Not generalizable to clinician groups not fully functioning with EMR **Conclusion:** Findings support use of built-in protocols and advanced clinical decision tools to improve healthcare outcomes with rapid rates of improvement noted

Author and Title	Conceptual Framework	Design/Method	Sample/ Setting	Major Variables Studied	Measurement of Major Variables	Data Analysis	Study Findings	Level & Quality of Evidence. Study Strengths and Weaknesses
10) Congdon, H., Eldridge, B., & Truong, T. (2013) *Development and implementation of a navigator-facilitated care coordination algorithm to improve clinical outcomes of underserved Latino patients with uncontrolled diabetes*	Not stated BHT and IMB principles implied	Report on Quality improvement process study NAVCOM was created to direct underserved Hispanic patients with DM2 into group or individual DSME, nutrition counseling, and/or MTM based on specific patient criteria; integrated into patient care plan and measured clinical outcomes	N= 58 for referral services 45 with A1C data available 32 of 45 were identified as Latino other 13 race not identified Inclusion criteria: Using computerized registry, Latino patients with A1C >9.0 % were identified and were contacted by phone according to the algorithm Setting: CHC in Montgomery County, MD	IV1= NAVCOM No control group Process improvement implementation applied to all included patients DV1= A1C	Scales to measure A1C not described	At the time of data collection, patients had participated for up to 6 months	A1C average decreased from 10.6 % to 8.8 %	**Level of Evidence:** Level VII **USPSTF grading schema:** Grade: C Quality of Evidence: Fair **Strengths:** Supports use of algorithms to improve DM care in minority populations Supports collaboration of healthcare professionals and multi-dimensional approach to improve DM outcomes Identified barriers to care Algorithm included in study **Weaknesses:** Not an RCT Data analysis not described Small sample size **Conclusion:** Use of NAVCOM demonstrated that patient navigation combined with use of a consistent patient algorithm and interprofessional collaboration had a positive impact on clinical outcomes, specifically A1C, for low-income, uninsured, primarily Latino patients with DM

Key:

A= Age, AA= African American, BGL= Blood glucose level, BHT= Behavioral health theory, BP= Blood pressure, CCM= Chronic care model, CBPR= Community-based participatory research, CC-TA= Community clinic following treatment algorithm, CC-SC= Community clinic following standard care, CDMP= comprehensive diabetes management program, CHC= Community health center, CS= Comparative Study, CV= Cardiovascular, DRS= dietary risk score, DSI= Diabetes summary index, DSME= Diabetic self-management education, DTSQ= Diabetes Treatment Satisfaction Questionnaire, EMR= Electronic medical records, FBG= Fasting blood glucose, G= Gender, HDL= High-density lipoprotein, HS= High school, ICCM= Improved care coordination models, IM=Internal Medicine, IMB= Information-motivation-behavioral skills model, LDL= Low-density lipoprotein, MA= Mexican American, MTM= Medication therapy management, MVAHCS= Minneapolis VA Health Care System, NA= Native American, NAVCOM= Navigator-facilitated care coordination algorithm, PACIC= Patient Assessment of Chronic Illness Care Survey, PAID= Problem areas in diabetes scale, PC= Primary Care, PAI= Physical activity index PCS= Prospective controlled study, PCAT= Patient Care assessment tool, RCT= Randomized controlled trial, R= Race, Ed= Education, SES= Socioeconomic status, SBGM= Self blood glucose monitoring, TC= Total cholesterol, TDD= total daily insulin dose, TIPS= Trust in physician scale, UC-TA= University clinic following treatment algorithm

Appendix B

Synthesis Tables

Synthesis Table 1: Measurements of studies and report of success

	Primary Author and Publication Year									
Measurements	Glazier, et al. (2006)	Shaw, et al. (2014)	Ishani, et al. (2011)	Mader, et al. (2014)	Rothman, et al. (2005)	Allen, et al. (2011)	Welsh, et al. (2011)	Fanning, et al. (2004)	Guzek, et al. (2009)	Congdon, et al. (2013)
A1C	X *	X *	X *		X *	X *	X *	X *	X *	X *
FBG	X *			X *				X *		
Blood pressure	X *	X *	X *		X *	X *	X *	X *	X *	
BMI/ Weight	X							X		
Lipids	X *	X *	X *		X	X *		X *	X	
Patient treatment adherence		X *						X *		
Provider protocol adherence		X *		X *						
Completed foot exam	X *	X *					X *	X *		
Aspirin use					X *		X *			

Completed eye exam	X *	X *					X *	X *		
Diabetes-related knowledge	X *				X *		X *			

Key: * indicates success in measured outcome after intervention

Synthesis Table 2: Components of Algorithms

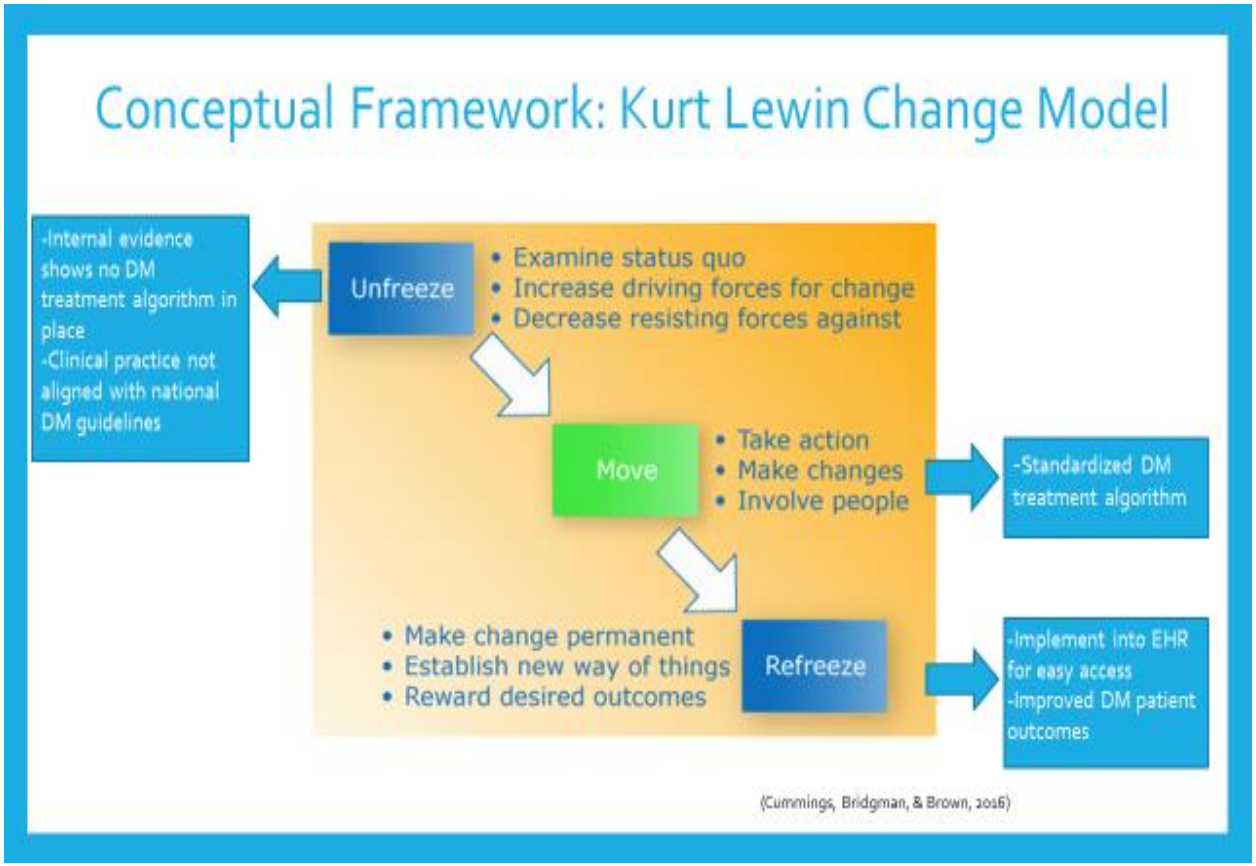
	Primary Author and Publication Year							
Components of Algorithm	Ishani, et al. (2011)	Mader, et al. (2014)	Rothman, et al. (2005)	Allen, et al. (2011)	Welsh, et al. (2011)	Fanning, et al. (2004)	Guzek, et al. (2009)	Congdon, et al. (2013)
Diet consult	X			X	X	X		X
Exercise consult	X			X		X		
Review medications	X			X		X		X
Document eye exam							X	
Document foot exam							X	
Initiate medication therapy	X	X	X	X	X	X		X
Step up therapy	X	X	X	X	X	X		X
Add ACEI/ARB			X	X	X	X		X

Synthesis Table 3: Provider of intervention, setting, and Hispanic Ethnicity

	Primary Author and Publication Year									
Who delivered intervention	Glazier, et al. (2006)	Shaw, et al. (2014)	Ishani, et al. (2011)	Mader, et al. (2014)	Rothman, et al. (2005)	Allen, et al. (2011)	Welsh, et al. (2011)	Fanning, et al. (2004)	Guzek, et al. (2009)	Congdon, et al. (2013)
Registered Nurse	X	X	X	X			X	X	X	X
Nurse Practitioner						X				X
Clinical Pharmacist	X				X					X
Community lay worker	X					X				
Other Medical Provider	X			X			X	X	X	X
Settings										
Medical Center	X	X	X	X						
Community Health Center	X	X				X	X	X	X	
Primary Care Office	X	X			X					
Hispanic/Latino as primary patient population	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES

Appendix C

Theoretical Model Schematic



Appendix D

IRB Letter

NORTHERN ARIZONA UNIVERSITY

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http://nau.edu/Research/Compliance/Human-Subjects/

To:	Heidi Dillenbeck
From:	NAU IRB Office
Date:	October 13, 2016
Project:	Implementation of a Diabetes Treatment Algorithm into the Hispanic Population
Project Number:	967860-1
Submission:	New Project
Review Level:	Administrative Review
Action:	RESEARCH - NOT HSR
Project Status:	Research - Not HSR

The project listed above does not require oversight by the Northern Arizona University Institutional Review Board because the project does not meet the definition of 'research' and/or 'human subject'.

- **Not Research as defined by 45 CFR 46.102(d):** As presented, the activities described above do not meet the definition of research as cited in the regulations issued by the U.S. Department of Health and Human Services which state that "research means a systematic investigation, including research development, testing and evaluation, designed to contribute to generalizable knowledge".
- **Not Human Subjects Research as defined by 45 CFR 46.102(f):** As presented, the activities described above do not meet the definition of research involving human subjects as cited in the regulations issued by the U.S. Department of Health and Human Services which state that "human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains data through intervention or interaction with the individual, or identifiable private information".

Note: Modifications to projects not requiring human subjects review that change the nature of the project should be submitted to the Human Research Protection Program (HRPP) for a new determination (e.g. addition of research with children, specimen collection, participant observation, prospective collection of data when the study was previously retrospective in nature, and broadening the scope or nature of the research question). Please contact the HRPP to consult on whether the proposed changes need further review.

Northern Arizona University maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #0000357).

Appendix E

Site Approval Letter

MOUNTAIN PARK
HEALTH CENTER
www.mountainparkhealth.org

October 5, 2016

To whom it may concern,

On behalf of Mountain Park Health Center, I am pleased to support the evidence-based practice project entitled "Implementation of a diabetes treatment algorithm into the Hispanic population " as proposed by Heidi Dillenbeck, MSN, FNP-C, DNP student.

In doing so, our practice agrees to serve as a research site for this project with provision that all patient and physician specific identifying information be removed from any and all publication arising from this project.

Sincerely,

[redacted]

Davider Singh, MD

Medial Director

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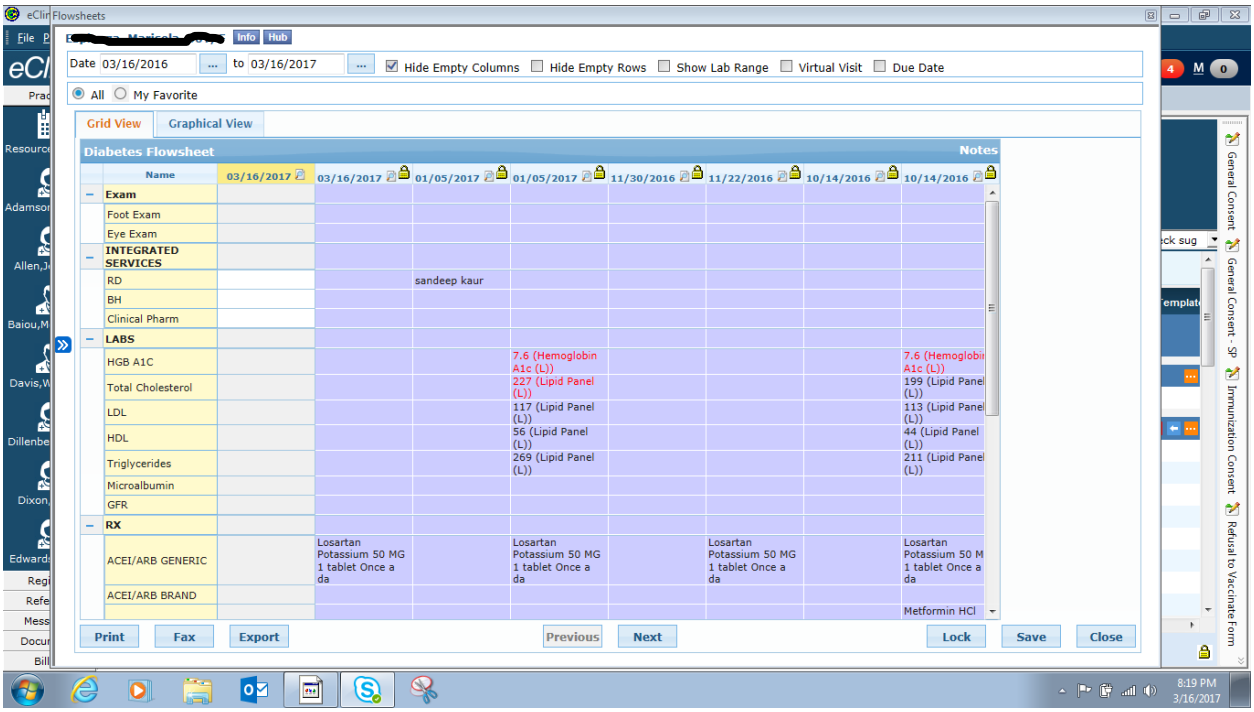
Appendix F

Image of Algorithm in EHR



Appendix G

Audit Tool

ID #	DM code	Annual Fo	A1C	A1C number	Lipid panel	Microalbumin	GFR	Statin	ASA	ACEI/ARB	DM meds	Wt. documented	Wt mgmt	
1	E11.9	N	Y	8.1	N	N	Y	Y	N	Y	N	Y	N/A	
2	E11.9	N	Y	8.4	Y	Y	Y	Y	Y	Y	Y	Y	Y	
3	E11.9	Y	Y	6.7	Y	Y	Y	Y	N/A	N/A	N/A	Y	N	
4	E11.9	N	Y	7	Y	N	N	Y	Y	Y	Y	Y	Y	
5	E11.9	N	Y	10.3	N	N	N	Y	N	Y	Y	Y	N	
6	E11.9	N	Y	7.1	Y	Y	Y	N	N	N/A	N/A	Y	N/A	
7	E11.9	N	Y	9.2	Y	Y	Y	Y	Y	Y	Y	Y	N	
8	E11.9	Y	Y	8.2	Y	N	N	Y	Y	Y	Y	Y	N	
9	E11.9	N	Y	6.5	Y	N	N	Y	N	N	N/A	Y	N/A	
10	E11.9	N	Y	7.9	Y	Y	Y	Y	Y	Y	Y	Y	Y	
11	E11.9	N	Y	6.2	Y	N	N	Y	Y	Y	N/A	Y	N	
12	E11.9	N	Y	8.6	Y	Y	Y	Y	Y	Y	Y	Y	N	
13	E11.9	N	Y	6.7	Y	Y	Y	Y	Y	Y	N/A	Y	N	
14	E11.9	N	Y	6.6	Y	Y	Y	Y	Y	N/A	N/A	Y	N	
15	E11.9	Y	N	N/A	N	N	N	N	N/A	Y	N/A	Y	Y	
16	E11.9	N	Y	8.4	Y	N	N	Y	N	N/A	Y	Y	N	
17	E11.9	N	Y	8.1	Y	Y	Y	Y	Y	Y	N	Y	N	
18	E11.9	Y	Y	9.5	Y	Y	Y	Y	Y	Y	Y	Y	N	
19	E11.9	N	Y	7.4	Y	Y	Y	Y	Y	Y	Y	Y	N	
20	E11.9	N	Y	8.6	Y	Y	Y	Y	Y	Y	Y	Y	N	
1	E11.9	Y	Y	7.1	Y	N	N	Y	Y	Y	N/A	Y	N	
2	E11.9	Y	Y	9.2	Y	Y	Y	Y	Y	Y	Y	Y	N	

Appendix H

Project Timeline

Project Phase	**Milestone**	**Estimated Completion**
Initiation	Identified practice change project. PICOT established	Completed
	Critical appraisal, evaluation, and synthesis of evidence	Completed
Planning	Formulate practice recommendations. Algorithm	Completed
	Develop treatment algorithm and chart audit form	6/2016
	Identify population. Family practice providers (2 MD, 1 DO, 1 NP) With focus on Adult Hispanic patients with DMII	6/2016
	Meet with EHR champion to input algorithm into EHR	7/2016
	Scholarly project proposal	8/2016
	IRB approval	8/2016-9/2016
Implementation	Educate providers on use of algorithm, including ppt with significance of problem.	9/2016

	Assess knowledge through pre/post test	
	Meet with operations director and medical director to approve and set go live date	9/2016
	Implement use of algorithm by all FP providers (MD, DO, FNP) on all adult Hispanic diabetics	9/2016 – 8/2017
Measurements/ Outcomes	Collect data. Utilize chart audit form	9/2016 – 12/2016
	Analyze data	1/2017
	Refine practice and processes	2/2017
	Disseminate findings internally at provider meeting. Disseminate findings externally at conference	5/2017

Appendix I

Participating Providers' Characteristics

Characteristic	Frequency	Percent	Mean ± SD
Age (y)	4	100	37 ± 2.160
Gender			
Male	1	25	
Female	3	75	
Race			
Asian-Hispanic	1	25	
East Indian	1	25	
White	2	50	
Job Title			
Medical Doctor	2	50	
Doctor of Osteopathic Medicine	1	25	
Family Nurse Practitioner	1	25	
Years of Experience			
≤ 2 years	2	50	
3-5 years	1	25	
≥ 5 years	1	25	

Appendix J

Counts and percentages of occurrence of documentation in the algorithm by category

Category	Documented		Not Documented		Not Applicable	
	Counts (n= 87)	Percent	Counts	Percent	Counts	Percent
A1C	86	98.9	1	1.1		
Annual Foot Exam	30	34.5	57	65.5		
Lipid Panel	67	77	18	20.7	2	2.3
Microalbumin	31	35.6	56	64.4		
GFR	44	50.6	43	49.4		
Statin	61	70.1	8	9.2	18	20.7
Aspirin	50	57.5	15	17.2	22	25.3
ACEI/ARB	63	72.4	5	5.7	19	21.8
Med Added/Titrated	33	37.9	10	11.5	44	50.6
Weight Measured	85	97.7	2	2.3		
Weight Management	11	12.6	65	74.7	11	12.6