

University of Northern Colorado

Scholarship & Creative Works @ Digital UNC

Capstones & Scholarly Projects

Student Work

7-2016

An Electronic Health Record Type 2 Diabetes Management Program Implementation and Outcomes in a Rural Practice

Cheryl Laux

University of Northern Colorado

Follow this and additional works at: <https://digscholarship.unco.edu/capstones>

Recommended Citation

Laux, Cheryl, "An Electronic Health Record Type 2 Diabetes Management Program Implementation and Outcomes in a Rural Practice" (2016). *Capstones & Scholarly Projects*. 10.
<https://digscholarship.unco.edu/capstones/10>

This Capstone is brought to you for free and open access by the Student Work at Scholarship & Creative Works @ Digital UNC. It has been accepted for inclusion in Capstones & Scholarly Projects by an authorized administrator of Scholarship & Creative Works @ Digital UNC. For more information, please contact Nicole.Webber@unco.edu.

UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

AN ELECTRONIC HEALTH RECORD TYPE 2 DIABETES
MANAGEMENT PROGRAM IMPLEMENTATION AND
OUTCOMES IN A RURAL PRACTICE

A Capstone Research Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Nursing Practice

Cheryl Laux

College of Natural and Health Sciences
School of Nursing
Nursing Practice

July 2016

This Capstone Project by: Cheryl Laux

Entitled *An Electronic Health Record Type 2 Diabetes Management Program Implementation and Outcomes in a Rural Practice*

has been approved as meeting the requirement for the Degree of Doctor of Nursing Practice in College of Natural and Health Sciences, School of Nursing, Program of Nursing Practice.

Accepted by the Capstone Research Committee

Rhonda Squires, Ph.D., APRN-BC, FNP, Research Advisor

Melissa Henry, Ph.D., RN, FNP-C, Committee Member

Kevin Harriger, MSN, APRN-BC, FNP-BC, NREMT-P, Community Representative

Accepted by the Graduate School

Linda L. Black, Ed.D.
Associate Provost and Dean
Graduate School and International Admissions

EXECUTIVE SUMMARY

Laux, Cheryl. *An Electronic Health Record Type 2 Diabetes Management Program Implementation and Outcomes in a Rural Practice*. Unpublished Doctor of Nursing Practice capstone project, University of Northern Colorado, 2016.

Type 2 diabetes mellitus is a chronic disease affecting 26 million people in the United States or 8.3% of the population. The prevalence of diabetes is rapidly increasing and increases with age. Treatment guidelines for Type 2 diabetes mellitus have been developed by the American Diabetes Association (2015) to decrease mortality and morbidity in patients with the disease. Utilization of current guidelines is a major component of providing evidence-based care. With the advent and widespread usage of electronic health records (EHR), a vehicle for point-of-care inclusion of accepted standardized guidelines exists. Including a reminder alert system within an existing EHR triggers providers to comply with current guidelines. Implementation of such a reminder system within a rural family medicine practice increased compliance with established guidelines. The guidelines measured in this study were blood pressure measurement at last visit, measurement of glycosylated hemoglobin within the last six months, and prescribed statin pharmacologic therapy. Glycosylated hemoglobin measurement increased by 16%, blood pressure measurement improved by 13%, and treatment with statin therapy increased by 16%. Implications for practice are inclusion of other Type 2 diabetes mellitus guidelines into the reminder alert system. Expansion of this system to

include other chronic diseases with accepted evidence based guidelines may be designed and implemented based on this project.

TABLE OF CONTENTS

CHAPTER I. PROBLEM STATEMENT	1
Introduction and Background	1
Research Question	2
Background and Significance of Project.....	2
National, Regional, and Local Statistics	5
Financial Impact.....	6
Diabetes Guidelines	6
Electronic Health Record and Clinical Support Tools.....	9
Theoretical Framework	10
Project Objectives	12
Summary	13
CHAPTER II. LITERATURE REVIEW AND PROJECT DESCRIPTION	15
Literature Review Parameters	15
Summary, Critical Review, and Synthesis of Literature.....	16
Summary	20
CHAPTER III. PROJECT DESIGN.....	21
Setting	21
Evidence-Based Project Plan	22
Ethics and Human Subject Protection.....	26
Timeline	26
Resources, Personnel, Technology, and Budget.....	26
Evaluation Plan	26
Reminder Design	27
CHAPTER IV. RESULTS.....	28
Results Linked to Problem Statement and Evaluation Plan	28
Sources of Data	30
Key Facilitators and Barriers That Impacted Project's Objectives.....	31

CHAPTER V. CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS	36
Recommendations Related to Problem Statement, Supporting Organization, Key Stakeholders, and Student	36
Recommendations Within Framework of Organization’s Strategic Plan	37
Contribution to Personal Goals in Advanced Practice Nursing	39
Summary	40
REFERENCES	41
APPENDIX A. PATIENT PAPER CHART	46
APPENDIX B. THE CHRONIC CARE MODEL	48
APPENDIX C. STATEMENT OF MUTUAL AGREEMENT	50
APPENDIX D. INSTITUTIONAL REVIEW BOARD APPROVAL	52
APPENDIX E. ALERT MESSAGE SCREEN SHOT	54

LIST OF TABLES

1.	Population Characteristics	22
2.	Components Measured per American Diabetes Association Guidelines	30

ABBREVIATION KEY

CCM	Chronic Care Model
EBP	Evidence based practice
EHR	Electronic health record
HgA1C	Glycated hemoglobin
IT-	Information Technology
LDL	Low density lipoprotein
T2DM-	Type 2 diabetes mellitus

CHAPTER I

PROBLEM STATEMENT

Introduction and Background

Management of complex clinical information is required in the care of the patient with diabetes. Use of an electronic health record (EHR) has the potential to improve this information management and, thus, the quality of care and outcomes of patients with diabetes. Institution of a diabetes disease management system within the EHR to improve patient care was the goal of this project.

A rural family practice medical clinic instituted an EHR system in 2012—Healthland (2016). Institution of the software has slowly progressed and includes the capability to utilize clinic and provider specific modifications. The capability to add diagnosis-specific decision support tools is also possible. Reminder systems have been studied and data reviewed for the purpose of instituting such a system in this rural family medical practice. Implementing the capability of the software was a component of this disease management system project.

Prior to the conversion to EHR, a card was kept in each diabetic patient's paper chart. It contained patient care guidelines and a spreadsheet for provider documentation of guideline compliance and a visual aid to view trends in measurements (see Appendix A). When the EHR conversion occurred, there was no process to continue the previous method for guideline use and monitor compliance and outcomes of treatment. An easy to

use process of tracking guideline compliance that incorporates an automatic prompt would be highly valuable for care of patients with diabetes in this setting.

Use of such a software reminder system also has value in quality measures and statistical compilations of clinical outcomes. The Affordable Care Act U.S. Department of Health and Human Services [USHHS], 2012) requires the reporting of some of this information and the groundwork was established by the proactive integration of a software reminder system in the EHR to achieve the required reporting. The Affordable Care Act also proposes payment based on guideline outcome ratings (USHHS, 2012, pp. 613-642). The practice can use this system to measure provider compliance with disease management guidelines as well as motivate improvement for financial gain.

In the near future, the impact of chronic illness on health and increasing health care costs will require the use of stronger evidence, better tools, and more effective practice systems. This could be a major step in this medical practice for improved chronic disease management.

Research Question

The following research question guided this study:

- Q1 Can the design and implementation of a diabetes management clinical decision support tool in to an existing electronic health record improve compliance with established evidence-based guidelines?

Background and Significance of Project

Diabetes is a group of metabolic diseases marked by hyperglycemia, resulting from deficits in insulin secretion, insulin action, or both. It occurs when the body no longer responds effectively to endogenous insulin or when the body's production of insulin is inadequate. Chronic hyperglycemia leads to abnormal metabolism of

carbohydrates, fats, and proteins. This chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and organ failure.

Abnormal pancreatic islet cell function is a key and requisite component of Type 2 diabetes mellitus (T2DM) pathology. In early disease stages, insulin production is normal or increased in absolute terms but disproportionately low for the degree of insulin sensitivity, which is typically reduced in T2DM. Insulin kinetics such as the ability of the pancreatic beta-cell to release adequate hormone in response to rising glycemia are profoundly compromised. In T2DM, pancreatic alpha-cells hypersecrete glucagon, promoting hepatic gluconeogenesis; glycogen is converted to glucose creating hyperglycemia. Glucagon secretion is not suppressed in the pancreatic cell dysfunction of pre-diabetes and T2DM and hepatic glucose production rises; the counter-regulatory mechanisms between insulin and glucagon do not work. A post-prandial increase in glucose concentration occurs despite an initial threefold increase in endogenous insulin production. This intensifies insulin resistance.

In most patients with T2DM, especially the obese, insulin resistance in target tissues (liver, muscle, adipose tissue, and myocardium) is a prominent feature. Insulin resistance results from defective glucose utilization within peripheral target organs and is most pronounced in skeletal muscle cells. The result is both glucose overproduction and underutilization. Elevated levels of plasma glucose become cytotoxic and lead to loss of beta-cell function and mass. The ability of the beta-cells to produce optimal insulin levels eventually fails due to apoptosis caused by the exposure to increasing plasma hyperglycemia (Unger, 2013).

An increased delivery of fatty acids to the liver favors their oxidation, thereby contributing to increased gluconeogenesis and the overabundance of lipids, promoting hepatosteatosis. More recently, incretin system abnormalities have also been found in T2DM. The incretin defect, which is also believed to be due to a resistance, results in increased glucagon secretion, fails to delay gastric emptying, reduces satiety, and promotes adipocytes to store triglycerides. Obesity develops.

Hyperglycemia leads to microvascular diseases: retinopathy, nephropathy, and neuropathy. It also contributes to premature macrovascular disease: stroke and myocardial infarction. Complications of diabetes are a major source of morbidity in the United States: the development of premature coronary heart disease, stroke, peripheral vascular disease, renal failure, and amputation (Unger, 2013).

Both genetic and environmental factors lead to the development of T2DM. The most dominant determinant seems to be one's body mass index; weight reduction and increased physical activity can therefore serve to delay or prevent the development of T2DM. The Diabetes Prevention Program (Centers for Disease Control and Prevention [CDC], 1996), one of the largest randomized clinical trials, resulted in the reduction of T2DM by up to 71% utilizing lifestyle interventions. Multiple pharmacologic therapies can delay the progression of T2DM and its complications. In addition to pharmacological therapies, reducing risk in T2DM involves the effective implementation of lifestyle behaviors that prevent or slow the progression of diabetes complications. Although diabetes care processes and outcomes have improved over the past 10 years, currently one of five persons with diabetes has poor glycemic control, one of three has

poor blood pressure control, and two of five have poor low-density lipoprotein (LDL) cholesterol control (Boren, Gunlock, Schaefer, & Albright, 2007).

National, Regional, and Local Statistics

“The global epidemic of T2DM is one of the major public health problem of the 21st century and the fifth leading cause of death worldwide” (Sanghera & Blackett, 2012, p. 1). In 2011, the number of people in the United States with diabetes reached nearly 26 million or 8.3% of the population. The prevalence of diabetes increases with age: 26.9% of people aged 60 years or older have diabetes--more than one in four. The Center for Disease Control (2007) predicts if current trends continue, one in three people born in 2000 will eventually develop diabetes. With increasing numbers of the obese, the elderly, and high-risk minority groups in the population, prevalence is increasing.

In Nebraska, the site of this rural family practice clinic, as well as in the rest of the United States, the prevalence of diabetes is increasing. According to 2008 data collected by the Behavioral Risk Factor Surveillance System (Nebraska Diabetes Prevention Program [DPP], 2010), the number of Nebraska residents age 18 years and older with diagnosed diabetes is estimated at 103,000--7.8% of the state's adult population, which is slightly below the national median of 8.3%. Behavioral Risk Factor Surveillance System data indicate there are over 63,000 adults in Nebraska who have been diagnosed with pre-diabetes. Two trends in Nebraska suggest the size of Nebraska's diabetic population is unlikely to decrease: (a) the increase in the incidence of obesity is accompanied by an increase in diabetes and Nebraska's prevalence of obesity has doubled in less than two decades and (b) the risk of diabetes increases with age and

Nebraska's population is getting older with 17.2% of Nebraska residents currently 65 or older.

Financial Impact

The global costs of T2DM are expected to increase from \$376 billion in 2010 to \$490 billion in 2030 (Sanghera & Blackett, 2012). The financial burden of diabetes was \$174 billion in 2007 (Shahady et al., 2012). Costs continue to grow. In 2012, the estimated total economic cost was \$245 billion, a 41% increase based on 2007 data (Yang et al., 2013). This estimate contained \$176 billion in direct medical costs and \$69 billion in reduced productivity (CDC, 2007). Direct medical expenses are composed of hospital in-patient care, prescription medications to treat the complications of diabetes, antidiabetic agents and diabetic supplies, physician office visits, and nursing/residential facility stays. Indirect costs include those of increased absenteeism and reduced productivity while at work for the employed population, reduced productivity for those not in the workforce, inability to work as a result of a disease-related disability, and lost productive capacity due to early mortality.

Those diagnosed with diabetes have medical expenditures approximately 2.3 times higher than those without diabetes. Care for individuals diagnosed with diabetes accounts for more than one in five healthcare dollars in the United States; more than half of that is directly attributable to diabetes (Yang et al., 2013).

Diabetes Guidelines

The American Diabetes Association (ADA; 2015) linked suboptimal diabetes mellitus care to fragmentation of healthcare delivery systems and called for innovative, evidence-based, patient-centered care. The ADA guidelines advocate effective

interventions including provider education, diabetes mellitus self-management education, guideline-based checklists, point-of-care availability of guidelines, automated reminders, dedicated diabetes mellitus provider visits, diabetes mellitus registries, care management services, and specialty consultation (ADA, 2015; Singh & Haas, 2006)

Multiple guidelines for the treatment of T2DM have been published. American Diabetes Association (2012) guidelines include recommendations that include screening, diagnosis, and therapeutic actions known or believed to favorably affect health outcomes of patients with diabetes. A summary and comparison of the major sources including ADA and the American College of Endocrinology guidelines reveal they are very similar (Fisher & Kapustin, 2007). The *Standards of Medical Care in Diabetes* were revised in January of 2015 (ADA, 2015). Included in the guidelines are diagnosis, screening, classification, evaluation, management, prevention education, glycemic targets, screening for microvascular complications, cardiovascular disease, and risk management with specific population considerations. The primary objective of these clinical guidelines was to recommend clinical minimum standards of care based on scientific evidence and expert opinion.

The American Association of Diabetes Educators (Haas et al., 2013) also has standards for risk assessment and risk reduction to prevent or slow the progression of diabetes complications. These guidelines contain available references for the different components of T2DM standard adherence. These components can be divided into processes of care, treatment, and outcomes. Because quality care is multidimensional, it requires many different measures.

Processes of care provide quantitative indicators for improvements in care and the methods by which quality care is provided. Indicator measurement and monitoring make it possible to document quality of care and make comparisons over time between places. They also make it possible to make judgements and set priorities while supporting accountability. For this project, these processes of care involved those actions occurring at a routine primary care clinic visit such as measurements done or resulting from primary care ordered laboratory measurements. They are based on research evidence. The ADA (2015) is generally considered the United States' standard and was used for the purposes of this work. Processes of care included but were not limited to obtaining glycated hemoglobin level (HgbA1C), blood pressure determinations, fasting lipid panels, testing for urine albumin secretion with a spot urine albumin-to-creatinine ratio, and assuring the medication treatment included a statin and anti-platelet therapy. Process of care outcomes frequently chosen are based on their relationship to intermediate outcomes (Crossan et al., 2007).

Treatment consists of implementing an intervention for documented processes as recommended in guidelines. Treatments would include medication to treat an elevated HgA1C or an elevated blood pressure.

Outcomes include HbA1C > 8%, and blood pressure < 140/90. These outcomes are intermediate outcomes based on evidence that long-term complications are reduced when these outcomes are achieved. Awareness of target goals should be contained within the reminder system.

There is evidence to suggest systems developed in-house might lead practices to improve their adherence to guidelines and there is less evidence that commercially

developed systems improve adherence to clinical guidelines. Studies indicated support systems engineered by those who used the flow of care already in place within the specific EHR utilized had higher composite scores of desired clinical outcomes as well as higher scores of patient satisfaction with their provider (Holbrook et al., 2009). Provider compliance and utilization improved when a decision support system did not require making a web based connection during the visit or entering data more than once because the system was not fully integrated. Technical difficulties with cumbersome systems created negative provider perceptions and lower compliance scores. Systems that had patient notification systems linked to these guidelines had high patient and provider scores (Holbrook et al., 2009).

Electronic Health Record and Clinical Support Tools

Use of an EHR in ambulatory care settings has been widely recommended as a method for reducing errors, improving the quality of health care, and reducing costs. In the treatment of chronic diseases, use of an EHR is expected to increase quality by facilitating the management of complex clinical information, support evidence-based clinical decision making, lead to lower rates of missing clinical information, and improve the coordination of tasks among members of the healthcare team.

Current evidence evaluating EHR effectiveness was derived from a few intervention studies and from case study reports. Some studies documented improved diabetes patient outcomes after EHR usage, whereas others showed improvements in the process of diabetes care but not in patient outcomes (Costa, Fitzgerald, Jones, & Dunning, 2009). A randomized trial that assessed the impact of an electronic health record-based diabetes clinical decision support system on control of A1C, blood pressure,

and LDL cholesterol levels in adults with diabetes found significant improvement in A1C and some aspects of blood pressure control (O'Connor et al., 2011). This study also found 94% physician satisfaction with the system; moderate use of the support system persisted for more than one year (O'Connor et al., 2011).

Efforts to expand EHR usage in chronic care call for a methodology that not only focuses on technology but on the providing, implementing, and integrating information and guidelines into practice. The ability of EHR mechanisms to improve communication among health professionals and patients is apparent; constraints cited related to such implementation were frequently time and staff shortages (Costa et al., 2009).

Theoretical Framework

The theoretical foundation for this capstone project was the chronic care model (CCM). The CCM uses a systematic approach to restructuring medical care to create partnerships between health systems and communities. This approach is needed in our changing health care system and is especially applicable to chronic disease management. Wagner, Austin, and Von Korff (1996) developed this theory in the 1990s when they saw our system of treating acute episodic illness lacked a means to manage chronic disease. Proof has been offered for the ability of the CCM to improve chronic care outcomes (Mason, Levitt, & Chaffee, 2012).

The CCM was developed to improve patient health outcomes by changing the way ambulatory care is being delivered through six system change processes that focus on the implementation of patient-centered, evidence-based care. The aim of the CCM is to transform the daily care for patients with chronic illnesses from acute and reactive to proactive, planned, and population-based. It is designed to accomplish these goals

through a combination of effective team care and planned interactions; self-management support bolstered by more effective use of community resources; integrated decision support; and patient registries and other supportive information technology (Coleman, Austin, Brach, & Wagner, 2009).

An analysis of studies published since 2000 supported the CCM design as a method for improved patient care and health outcomes (Coleman et al., 2009). The CCM summarizes the basic elements for improving care in health systems at the community, organization, practice, and patient levels. It identifies essential elements of a healthcare system that encourages high-quality care of patients with chronic diseases: the community, the health system, self-management support, delivery system design, decision support, and clinical information systems (see Appendix B).

Encouragement of active engagement of patients in self-management has been shown to improve effectiveness and outcomes. Specific elements of methods to produce these outcomes are difficult to determine from existing data. Use of the CCM might provide an avenue for producing desired outcomes. High-performing healthcare organizations more often use different CCM components for successful outcomes: computerize reminders for patients and providers (clinical information systems), involve practitioners on quality improvement teams (healthcare organizations), incorporate guidelines supported by clinician education or computer support (decision support), provide patients with formal self-management programs (self-management support), and utilize a registry (clinical information systems; Coleman et al., 2009). Disease registries in the EHR can be used to establish patient-centered goals, monitor patient progress, and

identify lapses in care. The CCM has been used for diabetes care in primary care settings with positive outcomes reported (Stellefson, Dipnarine, & Stopka, 2013).

The particular focus for this project was the clinical information systems component with a goal to organize patient and population data to facilitate efficient and effective care. Effective chronic illness care is virtually impossible without information systems that assure ready access to key data on individual patients as well as populations of patients. A comprehensive clinical information system can enhance the care of individual patients by providing reminders and data summaries can help track care and outcomes. At the practice population level, an information system can also identify groups of patients needing additional care. These systems might be used for performance monitoring and quality improvement assessment.

With the signing of the Affordable Care Act in 2010 (USHHS, 2012), changes were created in our reimbursement infrastructures that are proving to advance models of prevention and chronic care provision. Grants were provided for pilot programs to evaluate chronic disease risk factors, conduct evidence-based public health interventions, and ensure individuals identified with chronic disease or at-risk for chronic disease received clinical treatment to reduce risk (Anderko et al., 2012). Meaningful use criteria derived from the ACA included several T2DM measures: HbA1C control, retinal eye exam, urine screening, foot exam, LDL management and control, and blood pressure management (Centers for Medicare & Medicaid Services, n.d.).

Project Objectives

There were three objectives for this capstone project: (a) use current EBP guidelines for T2DM to design an EHR disease management support reminder system

specific for this rural practice and EHR system, (b) implement an EHR disease management support program for T2DM within the functioning EHR, and (c) assess for change in compliance with established guidelines for T2DM diseases within the EHR.

The purpose of this project was to improve T2DM care using the EHR across a rural family practice clinic. Fashioning an electronic reminder system that replaces the current paper guideline (see Appendix A) used prior to the implementation of the EHR was intended to meet the identified need. Use of this system to measure disease management guideline compliance while improving processes of care and ultimately improving patient clinical outcomes was the goal of this project.

Summary

Type 2 diabetes mellitus is a chronic metabolic disease affecting significant numbers of patients. The financial impact to health care as well as the prevalence of T2DM is increasing. The continuing growth and financial impact of T2DM provide an impetus to consider incorporation of an EHR reminder alert system based on the CCM to improve outcomes in T2DM while facilitating adherence to the most current guidelines for T2DM.

Studies evaluating the effectiveness of the CCM in chronic care have shown use of this framework could result in improved outcomes. The paradigm shift from acute care visits to a prevention-based system not delivered in isolated visits could be more effective (Piatt et al., 2006). Patients' clinical, behavioral, psychological and diabetes knowledge outcomes improve with this shift in focus and use of the CCM. Systematic reviews consistently showed improvement in at least one process or outcome measure. Studies evaluating cost savings with systems that used the CCM for diabetes have shown

mixed results: in part, this is due to an inability to measure savings in reducing long-term complications. An analysis conducted by Bodenheimer, Wagoner, and Grumbach (2002) showed a reduction in Emergency Department visits as well as reductions in hospital stays. These results were similar to a study conducted by Adams et al. (2007) on chronic obstructive pulmonary disease and the CCM. Pooled data demonstrated patients with chronic obstructive pulmonary disease who received interventions with two or more CCM components had lower rates of hospitalization, emergency and unscheduled visits, and a shorter length of stay than those in control groups (Adams et al., 2007).

CHAPTER II

LITERATURE REVIEW AND PROJECT DESCRIPTION

Literature Review Parameters

A literature search was conducted using the keywords of diabetes guidelines, T2DM, EHR clinical decision support tools and glycemic control. Databases included in this search were CINAHL, The Cochrane Library (which includes The Cochrane Database of Systematic Reviews, The Cochrane Register of Controlled Trials, and The Cochrane methodology Register), the U.S. Department of Health & Human Services Agency for Healthcare Research and Quality, Medline, and Google Scholar. Sources from the American Diabetes Association (2015) were also used.

The search produced 74 articles and 24 articles were deemed relevant and used in this review. Quality, similarity and boundaries of included studies were based on the specificity of the research question. Inclusion criteria were those studies published in the English language in peer-reviewed sources. Study inclusion criteria included those written since 2005. Relevancy was initially determined by the inclusion of one or more key words. Population similarities were considered as well as the similarity of intervention. The outcome measurement included glycemic control. Exclusion criteria included those studies that did not target clinical practice or did not include a description of clinical decision support content or the clinician's interaction with the system.

Summary, Critical Review, and Synthesis of Literature

During and after this review, the significance and the impact of improved control of T2DM were well documented with multiple published guidelines for treatment. It was also noted there were many studies using EHR systems for improved patient care. Conflicting results were related to the actual improvement of outcomes versus the improvement of process and documentation.

The Diabetes Prevention Program (CDC, 1996), a large study documenting the delay and prevention of T2DM in those with pre-diabetes, instituted lifestyle modifications with significant success. This was one of several pilot programs started in the United States in response to the directives set forth in the Affordable Care Act (USHHS, 2012). The original study was funded by the National Institutes of Health and supported by the Centers for Disease Control and Prevention. The study demonstrated that making certain lifestyle changes and continuing them over time could prevent T2DM in people who are at risk. The potential for using this project to successfully identify, follow, and treat pre-diabetes is high in clinical practice. Measurement for meaningful use could be applicable.

A Cochrane review (Duke, Colaquiri, & Colaquiri, 2009) analyzed diabetes education and its impact on a number of outcomes including glycemic control and basic physical measures. The included studies were too short to assess long-term complications and cost effectiveness was not addressed. A primary outcome common to these studies was glycemic control measured by glycated hemoglobin (HgA1C). Secondary outcomes measured were physical measure of body mass index, blood pressure (BP), and lipids. The studies were divided to compare typical care to individual

care. There was no statistically significant change in glycemic control in any of the studies where baseline HbA1C was less than 8%. Concurrently, there were no improvements in physical measures either. Two included studies looked at self-management outcomes of diet and exercise management; one of them showed statistically significant improvements in body mass index.

No systematic reviews were found on the use of clinical decision support tools within the EHR. Many studies outside the time guidelines included represented the EHR as an effective tool to introduce practice guidelines into clinical settings as well as some data to validate the EHR as an effective medium for the evaluation of practice guidelines and their effect on patient outcomes.

Veterans Affairs (Nilasena & Lincoln, 1995) used computer-generated reminders as a way to improve compliance with diabetes prevention guidelines. Their data suggested the computer system improved care by facilitating documentation of guidelines and the ordering of recommended procedures or testing. This randomized controlled trial encompassed information from the medical history, physical exam, laboratory results, referrals, and patient education. Improvement in all compliance scores was seen; an average of 16.6% improvement in compliance scores was found. Again, the long-term effects of outcomes of the diabetic patient were not able to be measured. This study discussed the issue of over-compliance such as more frequent ordering of laboratory tests such as HbA1C and lipid levels. Costs were increased with over-compliance; Nilasena and Lincoln (1995) postulated some providers did blood tests at every encounter in a shotgun type approach rather than following guideline intervals. They made no speculation on the effect this might have on diabetic complications.

These process measures did not necessarily translate into outcome improvement in morbidity and mortality. An identified need for more long-term studies was found. Although complication rates decreased as HgA1C decreased, there were still instances where equivalent HgA1C levels had varying manifestations of diabetic complications. Also in question were premises within the guidelines themselves; lower HgA1C and LDL levels might not directly represent improved diabetes care. Determining whether lower levels were a function of medical treatment, patient motivation, or genetics was difficult. Yet the real dilemma remained in the process of activating patients. Using this information for clinic visit planning or outreach activation might be an area deserving focus. With current changes in healthcare, this information will be required and measured; its use remains to be seen.

The Mayo Health Systems Diabetes Translation Project (Montori, Dinneen, Gorman, Zimmerman, & Rizza, 2002) found planned care augmented by the EHR led to improved performance and metabolic outcomes in diabetes care. This study was of interest due to the length of study--24 months; most other EHR studies were six months or shorter. They also identified information from the use of clinical decision support tools influenced the practice management decision implementation to facilitate improvements in metabolic control, medication changes, or other strategies.

A systematic review (Kawamoto, Houlihan, Balas, & Lobach, 2005) of trials of clinical decision support systems identified features critical to success. Seventy studies were included in the analysis and found decision support systems improved clinical practice in 68% of the trials. System features that were likely to improve clinical practice were automatic provision of decision support as part of clinical workflow, provision of

recommendations rather than just assessments, provision of decision support at time and location of decision-making, and computer- based decision support (Kawamoto et al., 2005).

Multiple studies related to diabetes management and telehealth have been done and indicate the potential for improved self-care. The relevance of these studies to EHR use related to meaningful use and patient portal communication. If providers could electronically communicate and provide educational materials to patients in response to their access to their laboratory results or their diabetes questions, providers met meaningful use criteria with automated supporting documentation and the potential to measure outcome changes. Studies in underserved populations reported improved metabolic control with some reduction in cardiovascular risk.

A cross-sectional analysis of 50 practices at the New Jersey Medical School, which examined the use of the EHR and diabetes quality care, found insufficient evidence that process, treatment, and intermediate outcomes were improved with EHR usage (Crossan et al., 2007). Crossan et al. (2007) suggested implementing new health information technologies without attention to work flow redesign might create quality problems in patient care.

Wrobel et al. (2011) evaluated the use of an EHR registry for foot care that showed improved discrimination of the highest foot risk. This improvement was made via a dialogue tick box containing the International Diabetic Foot Classification System to improve the accuracy of coding foot risk (Wrobel et al, 2011). This dialogue tick box required the provider to mark an “X” when positive findings occurred and a free text

template note was automatically populated in the record. This led to better coding for patients with Grade 3 foot risk.

Summary

The literature review supported the main components of this capstone: (a) the use of accepted guidelines in evidence-based practice (EBP) improved outcomes in T2DM, (b) EHR usage has the potential to improve quality of care in T2DM and compliance with guidelines, and (c) a practice-specific reminder system increases the chance for compliance with guidelines and documentation. Reviews indicated longer studies are needed. Long-term studies of T2DM might provide evidence for mortality and morbidity reduction. Continued studies are needed as EHR systems continue to evolve.

CHAPTER III

PROJECT DESIGN

Setting

The setting was a rural health clinic in Nebraska (see Appendix C). This clinical practice included two satellite clinics and a critical access hospital. The ambulatory providers provided care at both satellite clinics. This network was a county non-profit system and was the only provider of health care in the county. The medical staff was composed of two physicians, one physician assistant, and two nurse practitioners. The nursing staff consisted of a nurse manager and six licensed practical nurses. One of these nurses served as the clinic's information technology super user or EHR specialist.

The population of the county is 4,889 with 3.5 persons per square mile and considered a rural, sparsely populated area. The median per capita income is \$21,881 with 14.7% below the poverty level. The population over the age of 65 is 18.1% and predominately White (U.S. Census Bureau [USCB], 2012).

Morrill County has a diabetes incidence of 9.2%, which is greater than the Nebraska rate of 7.9%. The rural clinic has a population of 3,216 patients; 9.4% of these have a diagnosis of diabetes (see Table 1). Gender statistics showed 141 of the patients with T2DM were female and 94 were male (USCB, 2012).

Table 1

Population Characteristics

Age	# of T2DM Patients	Gender Male	Gender Female
<40	9	4	5
40-75	167	68	99
>75	59	22	37
Total	235	94	141

Evidence-Based Project Plan

Use of current practice guidelines in the care of patients with T2DM was inconsistent, both within this practice and in the United States in general. Incorporation of these guidelines in the current EHR might lead to improved outcomes and possible complication reduction and/or elimination. Overall patient quality of life improvement as well as health care costs reduction might be the anticipated benefit of this project's implementation.

The rationale for this project was three-fold: reminder systems within the EHR have proven to improve guideline compliance; improved guideline compliance has resulted in decreased complications; and decreased complications resulting in cost reduction in emergency department and unscheduled clinic visits, decreased hospital stays, as well as less easily measured long-term chronic disease costs (Bodenheimer et al., 2002).

Plan development consisted of establishing a reminder system, implementation of this reminder system, and assessment of any change after this implementation. The reminder system consisted of an alert that automatically populated in a patient's EHR when the current problem list contained T2DM. Because this reminder was not based on the chief complaint of the current visit, an opportunity to remind those patients who might have been non-compliant with labs or BP monitoring presented itself. This had the potential of increasing awareness of guidelines with both the provider and the patient. Since patient education is required at every visit, the provision of T2DM education at every visit might be more likely. The reminder system included three main T2DM guidelines: blood pressure determination, HgbA1C measured within the last six months, and statin therapy for patients over 40 years of age.

The rationale for blood pressure determination was based on the guideline that recommends, "Blood pressure should be measured at every routine visit. Patients found to have elevated blood pressure should have blood pressure confirmed on a separate day" (ADA, 2015, p. S49). These recent guideline revisions adjusted the goal blood pressure to <140/90. Treatment of elevated blood pressure should include lifestyle changes and pharmacological therapy that includes either an angiotension-converting enzyme inhibitor or an angiotension receptor blocker.

Evaluation of glycemic control done by the measurement of HgbA1C performed on a sample of blood was recommended:

Perform the A1C test at least two times a year in patients who are meeting treatment goals and who have stable glycemic control. Perform the A1C test quarterly in patients whose therapy has changed or who are not meeting glycemic goals. Use of point-of-care testing for A1C provides the opportunity for more timely treatment changes. (ADA, 2015, p. S34)

Recommendations for statin treatment were also included in the new 2015 ADA revision and came about after consideration of the American College of Cardiology/American Heart Association guidelines. Because T2DM is considered a cardiovascular risk factor, statin therapy is advised on all patients over 40 years of age. The intensity of statin therapy recommended varied from moderate to high depending on the presence of other cardiovascular risk factors or the presence of overt cardiovascular disease (ADA, 2015, p. S52).

Assessment of change was triggered by automatic report runs generated within the EHR. These reports also served as another mechanism of improving awareness to providers. Improved provider awareness might serve to translate to improved patient awareness about current guidelines or recommendations.

Reminder triggers were (a) statin treatment, (b) blood pressure reading obtained at every routine visit, and (c) HgA1C measured within the last six months. The reminder trigger for statin therapy recognized the absence of a statin and the provider had the opportunity to cite a reason that included an intolerance or patient refusal. Blood pressure measurements were entered in the vitals tab to be captured. The HgA1C measurements were from the generated order entry and lab portions of the EHR. Labs done at any other facility and scanned into the document component were not measured. The provider, of course, at the time of receiving the automated reminder could verify the HgA1C measurement, although this was likely a rare circumstance. If the patient refused having an HgA1C performed due to cost or other reason, it was not captured but could be documented in the health maintenance module.

Report generation documented statistics before and after implementation. Outlier information captured within the EHR was summarized by the author. During report generation for the purposes of clinic use and further reminders, trigger adaptation and use these statistics could be viewed for each specific provider included in the system. Statistics could also be viewed by gender and age of patient. There was no mechanism in this capstone to measure the amount of HgA1C at goal. There was also no mechanism to delineate those patients who might have had more than one HgA1C measured in the six-month study period.

The need for improved diabetic outcomes was well-documented. Instituting a system for EBP/guidelines into the EHR was a need at this rural clinic. A nurse from this clinic attended training by the EHR platform company. Information was obtained about the specific feasibility of incorporating diabetes guidelines into the Healthland (2016) system; the system had the ability to add diabetes guidelines to the EHR.

Before the advent of EHRs in the clinic, a paper diabetic checklist was used by some providers. This list contained some of the current guideline criteria and served as a reminder for monitoring specific recommended aspects of diabetes care. With the current system, there was no functional mechanism for guideline adherence, reminder, or alert system. There is no easy way to continue to use paper checklists in an electronic health system. Implementing an alert system for guidelines was the intended goal of this capstone project.

A needs assessment for inclusion criteria was conducted. A review of current guidelines resulted in a plethora of criteria. Determination of the most important and useful guidelines and measurement of outcome, process, or guideline compliance was

completed. Part of this inclusion of decision-making was dependent on the software capabilities. This information was obtained during a software conference in October, 2014. Provider participation and input was obtained.

Ethics and Human Subject Protection

Exempt status approval was obtained from the Institutional Review Board of the University of Northern Colorado prior to conducting research at the supporting organization (see Appendix D).

Timeline

The timeline involved a two- to three-week period of software updates as well as training for necessary staff. Use of the trigger alert system was over a six-month time period. Data collection was done before and after implementation.

Resources, Personnel, Technology, and Budget

The resource was the clinic in this capstone as well as access to the EHR and the software. Personnel involved were the informatics nurse, providers included in the study, and their nurses. Coordination and contact with software support personnel was necessary.

Evaluation Plan

Evaluation was done after all data were collected. Each of the three components was analyzed separately to compare data collected before project implementation and six months after the project. The project as a whole was evaluated. The nature of this evaluation was based on the data obtained. Comments and/or suggestions of providers were included anecdotally. Data were accessed by selected lab results (HgA1C), selected medications (statins), and selected vitals (blood pressure).

The IT nurse who collated and generated this report had the ability to view provider documentation if a measure was not obtained including patient refusal, HgA1C measured at another laboratory, statin intolerance including liver disease, and cost-prohibition of obtaining laboratory tests or medication. Patient non-compliance for unknown or personal reasons was categorized together.

Results of this project could pave the way for further chronic and/or acute disease alert systems within the EHR. Learning the effect of integrating EBP guidelines into practice via the EHR and capturing accurate measurements of compliance with these guidelines in the EHR were valuable. Improving the quality of care to patients in this Nebraska practice was the ultimate goal.

Reminder Design

The reminder alert was designed within the Health Maintenance module of the Healthland (2016) platform. This alert message was attached to all EHRs coded T2DM in the problem list of the patient. It attached to both genders and patients 40 years of age or older. The alert cue was a red exclamation point by the patient's name when they had an open chart on a provider's worklist. When the provider opened that chart, the red exclamation point remained on the top following his/her name. The provider clicked on the Health Maintenance section of the chart and the alert message appeared. The alert message screen shot is provided in Appendix E.

CHAPTER IV

RESULTS

Results Linked to Problem Statement and Evaluation Plan

The design and implementation of a diabetes management clinical decision support tool in an existing EHR improved compliance with established evidence-based guidelines. Prior to the implementation of this project, the author, in conjunction with the IT nurse, obtained the total number of patients in this practice who had T2DM as a coded medical diagnosis. The demographics of these patients were obtained. These demographics were particularly relevant since the statin recommendation was dependent on age in T2DM.

The reminder system was designed by the author with the assistance of an IT nurse employed by the clinic. The reminder alert was designed within the Health Maintenance component of the software system. Limitations were inherent within the software but many of these were known and considered before design occurred. This trigger attached to any EHR in which T2DM was coded in the problem list. The reminder alert automatically triggered whenever a patient with T2DM registered for any type of clinic visit. This trigger could potentially be attached by gender and it was attached to both males and females. The trigger could be attached by age and was attached to age greater than 40 years. Data could be collected by selected labs and

HgA1C was the selected laboratory test. Data could be collected by selected medications and all statins in the formulary were attached. Data could also be collected by selected vitals and BP was selected. The trigger appeared as a red exclamation point on the provider's work list. When the provider entered the patient's chart, the red exclamation point appeared on the health maintenance component. When the provider clicked on this, a drop-down box appeared. This box included the link to the ADA (2012) guidelines. The provider was able to acknowledge the guideline or override and ignore it. If the provider chose to acknowledge it, he/she then clicked on the box for procedure performed, patient refused, or discussed procedure with patient. There was then a free textbox labeled reason. If the provider chose to override the guideline, he/she could select a date to obtain the procedure or a box could be checked to always exclude the health maintenance reminder for this patient. The term *procedure* was part of the software and could not be changed.

One complication that occurred in the initial set-up was the pharmacy formulary. The clinic system is integrated with the hospital system and the hospital pharmacy formulary did not include rosuvastatin (Crestor). The pharmacy had to write rosuvastatin into the formulary for it to be counted in data collection. They did this for the purpose of this project; however, the hospital pharmacy does not stock rosuvastatin for in-patient use. The consulting pharmacist and the medical staff dictated the formulary by class and cost. The addition of rosuvastatin to the formulary took a small amount of time and resources and occurred on the days of initial set-up.

Adherence to established guidelines were measured for three components of the ADA (2012) guidelines: HgA1C, blood pressure measurements, and statin pharmacologic treatment. Percentages were calculated both pre- and post-implementation (see Table 2).

Table 2

Components Measured per American Diabetes Association Guidelines

Clinical Measure	Pre-intervention #s (%)	Post-intervention #s (%)
HgA1C within 6 months	136 (57%)	167 (71%)
BP at last visit	202 (86%)	233 (99%)
Statin therapy (indicated only for patients >40)	119 (50%)	155 (66%)

Sources of Data

All data were collected from the EHR by the author with the assistance of the IT nurse employed in the clinic. Prior to implementation of the project, 57% of included patients had HgA1C measurements, 86% had blood pressure measured and documented, and 50% of patients > 40 years old were on statin medication. Following implementation of the reminder system 71% of T2DM patients had HgA1C measured, 99% had blood pressure recorded, and 53% were on statin therapy. These increases were clinically significant and consistent with the national studies (Nilasena & Lincoln, 1995). The number of patients with HgA1C values measured increased by 14% or 31 patients. This increase in laboratory assessment often leads to increased patient awareness in overall control, can lead to provider implementation of increased or additional pharmacologic treatment, as well as reinforcement of lifestyle changes.

Blood pressure measurement increased by approximately the same amount. This 99% compliance gives the provider the opportunity to assess blood pressure control and add treatment. The provider had the ability to access the link to ADA (2015) guidelines for blood pressure as well as treatment recommendations. Utilization of this link by providers was not a part of the project however. The prescribing of statin therapy increased the most--by 16%. This guideline was one of the newest ADA recommendations and might be reflected in the increase; the opportunity to assess for and add a statin might have first presented itself during the study timeframe. Increased use of statin therapy has the potential to lead to a decrease in vascular complications of T2DM.

Key Facilitators and Barriers That Impacted Project's Objectives

A key facilitator to this project was the increased awareness created by this project's institution in a small clinical network. Providers and nurses were informed of guideline items included prior to project implementation. This increased awareness served to facilitate discussions about these guidelines with patients on both levels of communication and education. This potentially increased project success.

Another facilitator was the clinics' nursing staff. Depending on provider preference and autonomy, nurses would acknowledge the guidelines and enter the date of the laboratory study or the date statin therapy was initiated. Continuing this trend while adding guidelines to the reminder system also might have the potential to increase compliance and success.

Another possible facilitator was a health fair. Patients were able to obtain HgA1C levels outside the clinical setting; 20 vouchers were distributed by clinic providers for free lab work and those who had to pay did so at a greatly reduced cost. These lab values

were not included in this project's statistics but the diligence involved in propelling patients to obtain the measurements improved patient care, compliance with guidelines, and possible long-term outcomes. Other pertinent laboratory studies were also done during this health fair that evaluated diabetic morbidity and, therefore, potentially improved patients' outcomes.

Multiple barriers might have had an impact on the achievement of this project's objectives. Barriers identified were patient or provider non-compliance, limitations within the software design, and the inability to capture laboratory study results when obtained at another facility. Patients who were not seen in the clinic for any reason during the study had little chance of impact although the study results reflected current compliance with the studied T2DM guidelines. Any patients with new T2DM diagnoses were not included.

Barriers related to patient compliance were noted as patients' refusal or failure to obtain recommended lab tests and/or take medications. The reason for refusal was not consistently documented as the comment box was optional for the provider. Some providers used this box but some did not enter a reason. Non-compliance exceptions included cost of lab test or medications and side effects of statin therapy. The decision to not make this a required field was to streamline the reminder alert system. Most providers did document this reason within their chart notes but it was beyond the scope of this project to study and collate these data. In retrospect, it would be this author's recommendation to include the reason for exception as a required field. This would make the guideline apparent, i.e., when or if another provider saw this patient, he/she would be able to easily access the reason for guideline non-compliance. Addressing statin non-

compliance could also be divided into those who truly had a side effect, those who had preconceived ideas about statin therapy and side effects, and those who just refused to take another medication.

Provider non-compliance was difficult to define. Informal discussions with the providers identified several issues; the most common was lack of time while trying to hurry and finish chart notes, accidental incompleteness, or attempting to institute an interval override to change the date of laboratory measurement for patient convenience or coinciding with other tests. One possible way of addressing this issue would be repetitive discussions at weekly medical utilization review meetings or routine provider compliance reports.

Barriers inherent within the software design were items within the drop box that could not be changed or modified. To acknowledge the guideline recommendation, the provider must enter the date completed and check a box reporting the procedure was performed for the guideline to be acknowledged. If a patient was at a face-to-face visit and they were going to do lab on that day or in the next few days, some providers went ahead and acknowledged it and some did not. As this study evolved, some providers had their nurses acknowledge the guideline if the patient was there for a T2DM visit and a recent lab was known to be done. Thus, project success might have increased during the study period as providers and the staff became more familiar with the process.

Although this project successfully increased ADA (2015) guideline adherence, there remains room for improvement. Given the reasons for statin therapy and obtaining HgA1C measurements were not consistently easy to access, compliance was not at or near 100%. Blood pressure measurements were very close at 99%. Making the reason

for non-compliance mandatory as stated above might complete the data picture. Because the statin medication therapy and laboratory measurement of the HbA1C involved patient compliance, it would not be expected that rates would be at 100%.

During the study period of this project, additional reminder trigger alerts were added for prostate specific antigen (PSA) measurement on men over 50 and this might have distracted from the project and increased alert fatigue. Alert fatigue increases as the number of required fields increase in an EHR, resulting in desensitization and increased probability of provider noncompliance. This PSA recommendation was added by IT as a meaningful health maintenance item.

Those patients who were not compliant with laboratory testing due to cost were given vouchers for an upcoming health fair; thus, HgbA1C compliance might have been even higher had these results been within the timeline of this project. A method for capturing these laboratory tests would need to be developed further. Because these laboratory results were performed by an outside laboratory, they were scanned into the EHR and not in the laboratory section where they could be part of the reminder alert system.

Implementation of an EHR Type 2 diabetes management program and outcomes in a rural practice resulted in improved compliance with evidence-based guidelines established by the American Diabetes Association (2015). Specifically measured were HbA1C measurements obtained at least every six months, blood pressure measured at every clinic visit, and pharmacologic treatment with a statin in patients over age 40 years with T2DM as a coded medical problem.

Patients with Hg1C measures improved by 14%. Documented indications for non-compliance were cost and patient refusal or no show. This improvement was a reasonable expectation for the first six months of the reminder alert system. Data collected in this study did not include the number of clinic visits made by the 235 patients. There is a callback system to remind patients when laboratory tests are due and a mechanism to ensure patients are seen at least yearly. The six-month study of this project did not necessarily include all of those yearly visits although most patients are seen much more frequently than that. Patients might have had laboratory studies done but might not have been seen in the clinic; they might have received a communication from their provider about the results. If they were not seen in the clinic, it was less likely a statin would have been started without that face-to-face visit. Thus, the trigger alert system would not help with patients who were not seen.

Blood pressure measurements were obtained 99% of visits--an increase of 13%. Pre-implementation statistics were good; thus, the increase was of lesser significance. Control of blood pressure was not measured nor was the treatment with an angiotensin inhibitor or angiotension II receptor blocker.

Treatment with statin pharmacologic therapy increased by 16%. Documentation captured for non-compliance revealed statin intolerance was the major reason. Comments such as muscle pain, elevated liver enzymes, or decreased memory were noted.

CHAPTER V

CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

Recommendations Related to Problem Statement, Supporting Organization, Key Stakeholders, and Student

Recommendations related to the problem statement would be the inclusion of a larger spectrum of the established guidelines. Goals pertaining to the inclusion of multiple guidelines of different measure would complicate computer run reports but could possibly be established with advanced IT assistance. Adding a mechanism to assess the rate of blood pressure readings at goal could be done; one would need to decide if all readings obtained within the time period would needed to be at goal and if there was a way to take extraneous conditions contributing to elevations into consideration

Inclusion of a monofilament exam of feet could be included although a consistent area within the EHR would need to be provided. A yearly ophthalmic examination is recommended and a method of assessing this could also be included. Angiotensin inhibitor use or angiotension II receptor blocker could be assessed as well as anti-platelet therapy.

Since many patients have perceptions about statin therapy based on opinion rather than experience, discussion with their provider might dispel some but not all of these

misconceptions. Multiple cost and insurance factors influence a patient's compliance with recommended medications: different rates of co-pay amounts for different statins, the prices vary from pharmacy to pharmacy, and limited insurance selection. Cash pay patients most often choose the cheapest alternative or might choose not to take some recommended medications. This rural clinic network has a prescription assistance program wherein a nurse helps with the submission of application forms to drug companies who have patient assistance programs for those with low incomes. Availability and income qualifications vary from company to company.

At the current time, the supporting organization does not have the budget for manpower to spend on IT development along this particular avenue. This author plans to assist the IT nurse with small, gradual incremental changes. The EHR platform does not have support staff available in a very timely manner for assistance and the staff responds with assistance erratically. A recommendation has been made for increased budgeting for design and development of further EHR reminder systems.

At another time, these statistics could be analyzed on a provider-specific basis. Providers could be given their compliance rates in an effort to facilitate increased compliance with guidelines. These statistics could also be adapted to quality assessment studies as well as used in insurance reviews.

Recommendations Within Framework of Organization's Strategic Plan

The supporting organization was limited within the EHR Healthland (2016) platform; network support was limited and often lengthy but could perhaps be facilitated with administrative support and perseverance. Administration and philosophy supported

compliance with accepted guidelines as well as compliance with meaningful use criteria and insurers' quality measures.

A barrier to this project was identified and had effects along at least two avenues: laboratory costs for obtaining the HgbA1C. In the clinical network where this project was implemented, many patients did not comply with laboratory studies due to cost. A health fair every year offered laboratory tests at a greatly reduced cost and these clinics had 20 vouchers for free laboratory tests. Unfortunately, this health fair was not conducted during the time period of this study. Because the results obtained were not done at the integrated laboratory, anyone who used the health fair for obtaining their HgbA1C was not included in the result statistics. Because these results were scanned into the EHR, they were searched by individual EHR number and compiled manually. A possible change in how these results are incorporated into the EHR or developing a possible way to have the report runs recognize these documents could add to a future study or quality assessment. In-house HgA1Cs were not possible at this institution. Some home monitors were becoming available for home performance of the HgA1C. The nurse for this author became familiar with this complication and put the date in the health maintenance reminder system when a lab from an outside facility or the health fair was signed and sent to be scanned into the document section of the EHR, improving the retrieval rate of patient-specific information and thus improving care.

Another improvement in this project would be the ability of the EHR to automatically capture the laboratory results. Currently, providers must manually acknowledge a laboratory test has been completed. Adapting the program to automatically capture laboratory tests would be a significant advantage. However, at this point in time, this

does not seem likely. The author and her nurse, together with the laboratory manager, are working on a way to have the laboratory result or its electronically signed order automatically acknowledge completion of the test. Adding this task to the clinic nursing staff is a consideration; some nurses are already doing this although it is not an accepted procedure at the current time.

Contribution to Personal Goals in Advanced Practice Nursing

The focus on evidence-based practice was a hallmark of this project and awareness of such was highlighted for all providers in this practice. The ability to measure and document compliance advanced the goals of advanced practice nursing also. Assessment of improvement in practice is an ongoing goal and motivational factor. With the increasing complexity and volume of practice guidelines and the amount of insurance reimbursement based on guideline compliance, having increased reporting capabilities built into EHR systems is valuable for quality patient care as well as productivity for healthcare providers and healthcare systems.

This experience has implications for the rural Nebraska practice network used for this study. Multiple chronic diseases have accepted guidelines. These guidelines are continually updated and revised. Having guideline access at the time of patient contact would improve provider recommendations and patient compliance. Continued utilization of this alert trigger and development of additional alert triggers for other chronic illnesses are planned for this practice. The experience with the EHR software platform, developing a reminder trigger system, and evaluating their use is advantageous to current nursing practice.

Summary

Type 2 diabetes mellitus is a chronic disease and is the fifth leading cause of death worldwide. The rapidly increasing prevalence of T2DM and its significant financial burden make medical treatment a priority in primary care. The use of an EHR in ambulatory care has increased the ability to facilitate management of complex clinical information and support evidence-based clinical decision-making. Expanding EHR usage in chronic care to integrate current practice guidelines has the potential to improve quality care and the outcomes of those patients with T2DM. Development of a system to do this within a current EHR platform was the focus of this project. A trigger reminder system was implemented in a rural Nebraska family practice network and improved compliance with accepted ADA (2015) guidelines in three processes of diabetes care: monitoring of HgA1C, blood pressure, and instituting statin therapy.

REFERENCES

- Adams, S. G., Smith, P. K., Allan, P. F., Arzuelo, A., Pugh, J. A., & Cornell, J. E. (2007). Systematic review of the chronic care model in chronic obstructive pulmonary disease prevention and management. *Archives of Internal Medicine*, 167, 551-561.
- American Diabetes Association. (2012). Standards of medical care in diabetes--2012. *Diabetes Care*, 35(Supplement 1), S11-S63.
- American Diabetes Association. (2015). Standards of medical care in diabetes. *Diabetes Care*, 38(Supplement 1), S1-S99
- Anderko, L., Roffenbender, J. S., Goetzl, R. Z., Millard, F., Wildenhaus, K., DeSantis, C., & Novelli, W. (2012). *Preventing chronic disease. Promoting wellness through the affordable care act: Workplace wellness*. Retrieved from https://www.cdc.gov/pcd/issues/2012/12_0092.htm
- Bodenheimer, T., Wagoner, E. H., & Grumbach, K. (2002). Improving primary care for patients with chronic illness: The chronic care model, part 2. *Journal of American Medical Association*, 288, 1909-1914.
- Boren, S. A., Gunlock, T. L., Schaefer, J., & Albright, A. (2007). Reducing risks in diabetes self-management: A systematic review of the literature. *The Diabetes Educator*, 33, 1053-1077.

Centers for Disease Control and Prevention. (1996). *National diabetes prevention program*. Atlanta: Department of Health and Human Services.

Centers for Disease Control and Prevention. (2007). *Diabetes fact sheet*. Retrieved from <http://www.cdc.gov/diabetes.com>

Centers for Medicare & Medicaid Services. (n.d.). *2011-2012 eligible professional clinical quality measures (CQMs)*. Retrieved from https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/downloads/CQM_EPs_2012_02_02.pdf

Coleman, K., Austin, B. T., Brach, C., & Wagner, E. H. (2009). Evidence on the chronic care model in the new millennium. *Health Affairs*, 28(1), 75-85.

Costa, B. M., Fitzgerald, K. J., Jones, K. M., & Dunning, T. (2009). Effectiveness of IT-based diabetes management interventions: A review of the literature. *BMC Family Practice*, 10(72), 1-8.

Crossan, J. C., Ohman-Strickland, P. A., Hahn, K. A., DiCicco-Bloom, B., Shaw, E., Orzano, A. J., & Crabtree, B. F. (2007). Electronic medical records and diabetes quality of care: Results from a sample of family medicine practices. *Annals of Family Medicine*, 5(3), 209-215.

Duke, S. A., Colaquiri, S., & Colaquiri, R. (2009). *Individual patient education for people with type 2 diabetes mellitus*. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19160249>

Fisher, M. L., & Kapustin, J. F. (2007). A practical guide for aggressive management of type 2 diabetes. *The Journal for Nurse Practitioners*, 3(4), 259-270.

- Haas, L., Maryniuk, M., Beck, J., Cox, C. E., Duker, P., Edwards, L., ... Youssef, G. (2013). National standards for diabetes self-management education and support. *Diabetes Care*, 36, S100-S108.
- Healthland Information Systems. (2016). *Healthcare IT solutions designed to fit*. Retrieved from healthland.com
- Holbrook, A., Thabane, L., Keshavjee, K., Dolovich, L., Bernstein, B., Chan, D., ... Gerstein, H. (2009). Individualized electronic decision support and reminders to improve diabetes care in the community: COMPETE II randomized trial. *Canadian Medical Association Journal*, 181(1-2), 37-44.
- Kawamoto, K., Houlihan, C. A., Balas, E. A., & Lobach, D. F. (2005). Improving clinical practice using clinical decision support systems: A systematic review of trials to identify features critical to success. *British Medical Journal*, 33, 330-337.
- Mason, D. J., Levitt, J. K., & Chaffee, M. W. (2012). *Policy & politics in nursing and health care* (6th ed.). St. Louis, MO: Elsevier Saunders.
- Montori, V. M., Dinneen, S. F., Gorman, C. A., Zimmerman, B. R., & Rizza, R. A. (2002). The impact of planned care and a diabetes electronic management system on community-based diabetes care. *Diabetes Care*, 25(11), 1952-1957.
- Nebraska Diabetes Prevention Program. (2010). *The impact of diabetes in Nebraska* [White paper]. Retrieved from http://dhhsne.gov/publichealth/Pages/diabetes_d
- Nilasena, D. S., & Lincoln, M. J. (1995). *A computer-generated reminder system improves physician compliance with diabetes preventive care guidelines* (Department of Medicine, Salt Lake Veterans Affairs Medical Center, Department of Medical Informatics). Salt Lake City, UT: AMIA.

- O'Connor, P. J., Sperl-Hillen, J. M., Rush, W. A., Johnson, P. E., Amundson, G. H., Asche, S. E., ...Gilmer, T. P. (2011). Impact of electronic health record clinical decision support on diabetes care: A randomized trial. *The Annals of Family Medicine*, 9(1), 12-21.
- Piatt, G. A., Orchard, T. J., Emerson, S., Simmons, D., Songer, T. J., Brooks, M. M., ... Zgibor, J. C. (2006). Translating the chronic care model into the community. *Diabetes Care*, 29, 811-817.
- Sanghera, D. K., & Blackett, P. R. (2012). Type 2 diabetes: Beyond GAWS. *Journal of Diabetes Metabolism*, 3(5), 1-12.
- Shahady, E., Brunton, S., Shannon, M., Cooke, C., Magwire, M., & Spollett, G. R. (2012). *Diabetes care: Challenges from a primary care perspective* [Brochure]. New York: HMP Communications, LLC.
- Singh, N., & Haas, L. B. (2006). Comparing glycemic control guidelines in diabetes care. *Excerpta Medica*, 1(1), 13-21.
- Stellefson, M., Dipnarine, K., & Stopka, C. (2013). The chronic care model and diabetes management in US primary care settings: A systematic review. *Preventing Chronic Disease*, 10, 1-21. doi:10.588
- Unger, J. (2013). *Diabetes management in primary care* (2nd ed.). Philadelphia: Lippincott, Williams & Wilkins.
- U.S. Census Bureau. (2012). *State and county quick facts* [White paper]. Retrieved <http://quickfacts.census.gov/qfd/31>

- U.S. Department of Health and Human Services. (2012). *The Affordable Care Act Title IV--Prevention of chronic disease and improving public health: Modernizing disease prevention and public health systems*. Retrieved from <http://www.healthcare.gov/law/full/index.html>
- Wagner, E. H., Austin, B., & Von Korff, M. 1996. Organizing care for patients with chronic illness. *The Milbank Quarterly*, 74(4), 511-544.
- Wrobel, J. S., Chagares, W., Stuck, R. M., Weaver, F., Crews, R. T., Rapacki, L., ...Armstrong, D. G. (2011). Creating a diabetes foot reminder-based registry using the electronic medical record. *Informatics in Primary Care*, 18, 283-289.
- Yang, W., Dall, T. M., Halder, P., Gallo, P., Kowal, S. L., & Hogan, P. F. (2013). Economic costs of diabetes in the U.S. in 2012. *Diabetes Care*, 1-14.
doi:10.2337/dc12-2625

APPENDIX A
PATIENT PAPER CHART

Guidelines of Medical Care for Adult Patients with Diabetes

These are guidelines to be adapted into the clinician's practice recommended by the Nebraska Diabetes Consensus Task Force.

Patient Name: _____ Date of Birth: ____/____/____ Year of Diagnosis: _____
 Tobacco Use Status: Uses _____ Doesn't Use _____
 Complications: _____
 Pneumococcal Vaccination (6) _____ (Date Given) _____ Height _____

**Frequency may be every diabetes-related visit - to be determined by physician*

Indicators	Frequency*	Goals (1)	Date/Results	Date/Results	Date/Results	Date/Results
Weight	every visit	desirable wt: _____				
Blood Pressure	every visit	<130/85 mm/Hg				
Foot Exam/pulses	every visit					
Skin/injection sites	every visit					
Blood Sugar	every visit					
Review of Self-Blood Glucose Monitoring Record	every visit	80-120 mg/dl pre-meals 100-140 mg/dl at bedtime				
Current Medications	every visit					
Smoking Cessation if still using	every visit					
Hemoglobin A1c -insulin treated -non-insulin treated	quarterly - 2-4 times a year or as needed	<1% above lab norm (e.g. norm <6; goal <7)				
Referred for Dental exam	bi-annual	Exam Date/Dentist:				
Annual Exam/History Update	yearly					
Abdominal Exam	yearly					
Neurological Exam	yearly					
Cardiac assessment/pulses	yearly					
Thyroid Assessment (2)	yearly					
Referred for Dilated eye exam(3)	yearly	Exam Date/ Physician:				
Total cholesterol (4)	yearly	≤ 200 mg/dl				
HDL-C (4)	yearly	> 45 mg/dl females > 35 mg/dl males				
Triglycerides (4)	yearly	≤ 200 mg/dl				
Calculated LDL assessment (4)	yearly	< 100 mg/dl				
Morning spot urine for albumin/creatinine ratio or 24 hour urine for micro albumin (5)	yearly	< 30 mg/24 hr				
Influenza Vaccine	yearly	Date/location:				

1. Based on American Diabetes Association: Standards of Medical Care for Patients With Diabetes Mellitus. Diabetes Care 22 (Suppl. 1): S23-S41, 1999.
2. Thyroid function tests when indicated.
3. Type 1 annually 5 years after onset and Type 2 annually both by ophthalmologist or optometrist experienced in management of diabetes retinopathy.
4. Lipid profile, annually. If within normal limits the clinician may consider obtaining less frequently.
5. Five years after diagnosis, then annually at adolescence for Type 1, at diagnosis for Type 2.
6. CDC Guidelines-once and repeat after 65 years of age if greater than 5 years after last vaccination. (MMWR Vol. 46 pg. 11).

APPENDIX B
THE CHRONIC CARE MODEL

Chronic Care Model



APPENDIX C
STATEMENT OF MUTUAL AGREEMENT

Statement of Mutual Agreement

University of Northern Colorado

Doctorate of Nursing Practice Capstone Project

Cheryl Laux October 1, 2015

The purpose of the "Statement of Mutual Agreement" is to describe the shared view between Morrill County Community Hospital and Cheryl Laux, DNP Candidate from University of Northern Colorado, concerning her proposed capstone project.

Proposed Project Title: EHR Type 2 Diabetes management program implementation and outcomes in a rural practice.

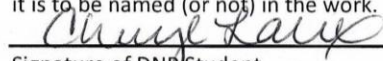
Brief Description of Proposed Project: 1) use current evidence-based practice guidelines for T2DM to design an EHR disease management support reminder system specific for this rural practice and EHR system, 2) implement the EHR disease management support program for T2DM within the functioning EHR system, 3) assess for change in compliance with established guidelines for T2DM disease within the EHR.

Goal of Capstone Project: To improve T2DM care using the EHR across a rural family practice clinic using an electronic reminder system by improved processes of care and improved patient clinical outcomes.

Proposed On-site Activities: Implement the project within the CDS Alert component of the EHR. Measure processes of care and outcomes.

A designated Agency member participated in the review and approval of the proposal and will be able to participate in the presentation of the final version of the project remotely.

The DNP Capstone project will include a final report, an abstract, potential publication or oral presentation of the report. No personal identifiers will be included and all data will be reported in aggregate form. The author welcomes any comments or suggestions from the Agency, but reserves the right to publish findings and analysis according to professional standards and principles of academic freedom. For any work of a scholarly nature, the Author agrees to follow the Agency preferences in how it is to be named (or not) in the work.



Signature of DNP Student



Signature of Agency Member

Rhonda D Squires PhD, APRN, FNP-BC

Digitally signed by Rhonda D Squires PhD, APRN, FNP-BC
 DN: cn=Rhonda D Squires PhD, APRN, FNP-BC, o=University of Northern Colorado, ou=School of Nursing, email=rhonda.squires@unco.edu, c=US
 Date: 2016.06.15 18:12:11 -06'00'

Signature of DNP Capstone Chair

APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL



Institutional Review Board

DATE: February 23, 2016

TO: Cheryl Laux, MSN
FROM: University of Northern Colorado (UNCO) IRB

PROJECT TITLE: [858564-2] EHR Type 2 Diabetes management program implementation and outcomes in a rural practice

SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVAL/VERIFICATION OF EXEMPT STATUS

DECISION DATE: February 23, 2016

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB approves this project and verifies its status as EXEMPT according to federal IRB regulations.

Cheryl -

Thank you for providing the requested amendments and documentation. Your research is verified/ approved exempt and you may proceed.

Best wishes with your capstone research. Don't hesitate to contact me with any IRB-related questions or concerns.

Sincerely,

Dr. Megan Stellino, UNC IRB Co-Chair

We will retain a copy of this correspondence within our records for a duration of 4 years.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

APPENDIX D**ALERT MESSAGE SCREEN SHOT**

Health Maintenance Specific Patient

MR # 1127150

CHRONIC PATIENT

Due Procedures

Due Date
10/10/2015
04/20/2016

Interval Date

2015

Annual Screening

2015

Diabetic Annual Lab

2015

Acknowledge - Health Maintenance - Diabetic Annual Lab

ACKNOWLEDGE

Completion Date * 10/13/2015

Completed

- ☐ Procedure Performed
- ☐ Patient Refused
- ☐ Procedure Cancelled
- ☐ Addressed Procedure with Patient

Reason

Interval Interval - Predefined

Next Due Date 04/10/2016

☐ Always excluded for Patient

SAVE