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Implementation of Electronic Medical Record HbA 1 c reminders for Adult Native Americans

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by

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Abstract

The learning project was developed to determine if using clinical decision support in an EMR can improve patient outcomes. Patient outcomes can be improved with implementation of a decision making tool, such as a reminder based on a clinical guideline, in an EMR. The practice recommendation in the project is to implement a computerized tool to trigger clinicians to order HbA1c in a patient that is determined to be prediabetic or has an increased risk factor such as being a Native American. Education of the clinicians would be needed to both inform them of the trigger and the recommendations of the results. Therefore, an education in-service was developed using adult learning theory as a framework.

Chapter I

Introduction of Electronic Medical Record Reminders

The education issue addressed in this independent study project is continuing education of clinicians in a clinic setting. The specific clinic is a tribal organization that serves Native American patients. Almost twice as many Native Americans adults are diagnosed with diabetes than non-hispanic whites (National Center for Chronic Disease Prevention and Health Promotion, 2011). And Native American age-adjusted diabetes death rates are almost 4 times higher than the US all-races rate and the prevalence in Native Americans younger than 35 years who are at an increased risk for complications and death earlier in life (Roubideaux, Noonan, Goldberg, Valdez, Brown, Manson, 2008).

Glycosylated hemoglobin (HbA1c) is commonly used to evaluate glycemia in diabetes. The American Diabetes Association (2011) has recently recommended HbA1c as a primary diagnostic test for diabetes. Native Americans have an increased risk to develop type 2 diabetes and 20% of Native Americans aged 15 years or older had prediabetes in 2001-2004 (National Center for Chronic Disease Prevention and Health Promotion, 2011). Prediabetes is a condition in which individuals have blood glucose or HbA1c levels higher than normal, but not high enough to be classified as diabetes. Monitoring for the advancement of diabetes in those with prediabetes should be performed yearly. Type 2 diabetes can be prevented or delayed in persons at high risk for the disease (Diabetes Prevention Program Research Group, 2002). Accordingly, patients with an HbA1c of 5.7-6.4% should be referred to a support or prevention program that focuses on lifestyle interventions to reduce the incidence of diabetes.

Electronic medical records (EMR) can offer clinical decision support triggers to support interventions. Clinical decision support systems are intended to aid clinician decision making

during the process of care (Wright, Sittig, Ash, Sharma, Pang, & Middleton, 2009). Such triggers could be set to reminder providers in primary care clinic settings to order HbA1cs as recommended by the American Diabetes Association (ADA) to monitor those at risk to develop type 2 diabetes.

Electronic medical records (EMRs) open new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. The independent study project looks at implementation of a decision making tool such as a reminder to see if it can have an increase in patient outcomes. The reminder systems or tool would support guidelines based on the individual articles clinical area. Management guidelines are ever more driving the practices of medicine and strong evidence show adherence to guidelines increase favorable outcomes for patients. There is still, however, a lack of complete understanding of clinical decision-making processes of health professionals. This lagging understanding and knowledge needs immediate attention so implementation of effective decision support tools such as trigger can succeed in improving patient outcomes.

The literature review will look to recommended to implement a computerized tool to trigger clinicians to order HbA1c in a patient that is determined to be prediabetic or has increased risk factors such as being Native American. Another recommendation would be to refer the patient based on the HbA1c outcomes to a diabetes prevention program as recommended by the ADA.

A trigger would be set in the clinic EMR based on the manufactures settings. The trigger would look for a diagnosis of prediabetes or risk factor of Native American and would trigger to order HbA1c according to ADA recommendations. Education of the clinicians would be necessary to inform both them of both the trigger and the recommendations of the results.

Therefore another literature review was done to see how adult learning theory is used as a framework for the in-service. Clinicians would then need to refer the patient to a diabetes prevention program if necessary and would need to be educated on the reason for the need of such programs. If the EMR provides triggers, there would be no additional computer or budget involvement.

Triggers could be set to remind providers in primary care clinic settings to order HbA1c as recommended by the ADA to monitor those at risk to develop type 2 diabetes. A trigger to order HbA1c in a prediabetic patient assists in monitoring the patient's risk to develop type 2 diabetes. Henderson states, "Despite today's advanced medical treatments, prevention, and health promotion strategies, prevalence rates for diabetes among Native Americans are persistent, excessive, and rising" (2010). Therefore the content of the independent study project sought strategies to trigger clinicians to implement interventions and education to those at risk, especially Native Americans with prediabetes. EMRs can be used as a tool to improve the quality of patient care (Wright et al, 2009).

Purpose

This independent study project will focus on developing an in-service for clinicians, including nurses, doctors, and nurse practitioners. The in-service will be grounded in the Adult Learning Theory. The in-service will cover implementation of triggers to remind clinicians to order HbA1c in adult Native Americans, a risk factor for diabetes. Triggers can help clinicians refer patient to diabetic prevention programs if necessary and to monitor their prediabetes.

Significance

Electronic medical records (EMRs) open new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. EMRs are

becoming an integral component of many primary care clinics (Holroyd-Leduc, Lorensettie, Straus, Sykes & Quan, 2011). Continuing education on best practices and uses of EMRs are essential for clinicians in a clinic setting. Also since the enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act, shows the government is committed to support health information technology

Theoretical Framework

Andragogy, or adult learning theory, is in glaring contrast to pedagogy, or child learning theory, which has formed the underpinning of most traditional education. In pedagogy's the learner is dependent upon the teacher to decide what, when, and how to learn (Regan-Smith, 1998). The teacher also decides if material has been learned. In contrast andragogy's learners are included in a process of developing increasing competencies. The competencies are learner determined as a result of the learner recognizing a need to learn in order to cope with a real life problem (Merriam, 2008). Learners have a need to know, motivating learning is the most critical feature of adult learning (Reagan-Smith, 1998). In 1968 Knowles proposed a theory of adult learning called andragogy, meaning "the art and science of helping adults learn" (Clapper, 2010). There are several assumptions underlying adult learning theory (Knowles, 1990; Kaufman, 2003):

1. Adult learners need to know the relevance of what they need to learn before undertaking to learn it
2. Adults prefer responsibility for their decisions and desire to be viewed as capable of self-direction
3. Adults accumulate a greater volume of experience, which represents a rich resource for learning and necessitates individualization of learning strategies

4. Adults become ready to learn things when they need to know them in order to cope effectively with real life situations
5. Adults have task-centered orientation to learning and life to feel free to focus on the task or problem
6. Students can work collaboratively and in dialogue with other when mutual trust and respect, between both peers and lecturers, to shape and deepen understanding
7. While adults are responsive to some external motivators, their most potent motivators are internal

Adults need to know why they are learning (Bryan, Kreuter, & Brownson, 2008). Adults have a need to be self-directed, deciding for themselves what they want to learn and learn best when convinced of the need for knowing the information (Russell, 2006). Adults have a greater depth, breadth, and variation in the quality of previous life experiences than younger people (O'Brien, 2004). Adults' previous experience must be respected and built upon (Bryan et al 2008). They will commit to learning when the goals and objectives are considered realistic and important to them and should be actively involved in the learning process (Das, Malick & Khan, 2008; Bryan et al, 2008). Adult learning theory proposes that adults are self-directed learners, having rich experiences and knowledge on which to draw, desire to apply learning to "real world", and see education as a process that increases competence and leads to achievement of their full potential (Hohler, 2003; Das et al, 2008; Russel, 2006). Russell cites a classic study by Rogers illustrating that when an adult learner has control over the nature, timing, and direction of the learning process; the entire experience is facilitating (2006). They are responsible for their education, and each person comes with his or her own styles and pace for learning, so involve learners in shared planning of appropriate methods and curricular content (Nelson, 1999).

Das, et al (2008) identified other important factors of adult learning, including the relationship of an individual's ego as part of the motivation for learning. It is along this line that professional development must be structured to provide support from peers and to reduce the fear of judgment during learning. Adults need to receive feedback on how they are doing and the results of their efforts. Transfer of learning for adults is not automatic and must be facilitated. Coaching and other kinds of follow-up support are needed to help adult learners transfer learning into daily practice so that it is sustained. Also, adults need learning approaches that match their background and diversity (Bryan et al, 2008).

Knowles advocated creating a climate of mutual trust and clarification of mutual expectations with the learner, a cooperative learning climate where learners feel safe and comfortable expressing thoughts and feelings (Kaufman 2003). Adults are motivated to learn by the need to solve problems (Bryan et al, 2008).

In summary, it is important to involve learners in diagnosing their own needs. This participation will help to trigger internal motivation. Learners gain control of their own learning when educators encourage them to formulate their own learning objectives, identify resources and devise strategies for using the resources to achieve their objectives. It then becomes the role of the educator to support learners in carrying out their learning plans. Ultimately, by involving learners in evaluating their own learning, they can develop their skills of critical reflection (Kaufman 2003).

Definition of Terms

Electronic Medical Records (EMR). A health record in electronic form accessed by a computer program (Gill, Mainous, Koopman, Player, Everett, Chen, Diamond, & Lieberman, 2011).

Interprofessional Learning. Facilitated interaction between students in multiprofessional groups (Freeman, Wright & Lindquist, 2010).

Triggers. A decision support tool such as a reminder (Safran, Rind, Davis, Ives, Sands, Currier, Slack, Cotton, & Makadon, 1996)

Assumptions

There are assumptions made in this independent study. Clinicians will have knowledge of the EMR as they use the system daily. However, they may have less knowledge of triggers and its potential uses for patient care.

Limitations

There are several limitations of the learning project. Clinicians will come to the in-service with a wide variety of educational background and experiences. The learning styles of the attendees will also most likely differ. This may mean the learning method may not be conducive to all learners. Determining learning styles will help identify the preferred conditions under which the in-service is likely to be most effective, but time constraints of both the project and in-service are barriers to determining the learning styles. Finally, the clinicians may have a lack of motivation to become fully engaged in the learning experience as the in-service will be a requirement and motivation in adult learning theory comes from the adult.

Chapter II

Literature Review

Continuing education on best practices and uses of EMRs are needed for clinicians in a clinic setting. Successful use of clinical decision support in EMRs was evident in the literature search. Electronic medical records (EMRs) open new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. EMRs are becoming an integral component of many primary care clinics (Holroyd-Leduc, Lorensettie, Straus, Sykes & Quan, 2011). Continuing education on best practices and uses of EMRs are needed for clinicians in a clinic setting. The independent study project content focused on reminding providers of the need to do laboratory testing, specifically HbA1c, in high risk patients using guidelines from the ADA. The EMR offers critical efficiencies in disseminating practice guidelines and in directing the physician's use of them (Rollman, Gilbert, Lowe, Kapoor, & Schulberg, 1999). This important feature of an EMR is the focus of the literature review. Electronic medical records (EMR) can offer clinical decision support triggers to support interventions based on clinical guidelines. Clinical decision support systems are intended to aid clinician decision making during the process of care (Wright et al, 2009).

Methods used to search the literature.

The University of North Dakota Harley French Library website was used to conduct a literature search. PubMed and CINAHL were the databases selected to search for relevant literature. PubMed was chosen because it is the largest biomedical database available, CINAHL was chosen because it is a comprehensive source for nursing (Mateo & Kirchhoff, 2009).

An initial Medical Subject Heading (MeSH) search in PubMed was conducted. "Diabetes Mellitus, Type 2" was the MeSH term most appropriate for "diabetes", "Indians, North

American" was the MeSH term appropriate for Native American, "Prevention and control" was the best MeSH term for "prevention", "Electonic Health Records" was the term used for "electronic medical records" and "practice guidelines" was most appropriate for "reminder". Therefore, the following MeSH terms were deemed applicable: "Diabetes Mellitus, Type 2", "Indians, North American", "prevention and control", "electronic health records", and "practice guidelines".

The initial search including all terms did not yield any results. Therefore, two separate searches were completed. The first used the terms "diabetes mellitus, type 2", Indians, North American", and "prevention and control". This yielded 103 results. Finally, titles and abstracts were reviewed for relevance. It was then determined that although articles pertaining to Native Americans, diabetes, and prevention are helpful to discuss the need for reminders, it is the usage of the electronic medical records to use reminders that is the more important issue.

"Electronic health record" was separated out from the search. This is because there may not yet be many studies regarding electronic health records, so a second separate search to include all studies with "electronic health records" and "practice guidelines" was done. This produced 33 articles. Titles and abstracts were reviewed for relevance reduced the results.

In CINAHL, CINAHL headings were used in the search. "Computerized patient record" was appropriate for "electronic medical records" and "practice guidelines" was used for reminders. Since it was determined the other terms were not as useful, only these two terms were used in the search.

Use of Electronic Medical Records Reminders

The literature review for the independent study project revealed many articles or studies related to the use of EMRs to aid clinicians. In an article discussing recommendations for

meaningful use, Das, Eisenber, House, Lee, Lusk, Nielsen, Patel, Stechiwych & Ermini (2011) stated use of a clinical decision support rule can be as simple as the EHR reminded to advise smoking cessation to smokers. Implementation of electronic health records improvements in technology and innovation bring promise to improve patient safety, quality, and efficiency (Das et al, 2011). The literature supported that triggers used in EMRs can be effective. In a study by Gill, Mainour, Koopman, Player, Everett, Chen, Diamond & Lieberman (2011) it was found clinical decision supports incorporated into an EMR has improvements in quality of care. In offices (n=27) with clinicians (n=119) and high risk patients (n=5234), a randomized controlled trial was conducted using an EMR to focus on patients taking traditional NSAIDs who had risk factors associated with a high risk for gastrointestinal complications. The offices were randomized to receive EHR-based guidelines and alerts for high-risk patients who received guideline—concordant care during the 1-year study period. The study suggested that when clinical decision support is incorporated into the EMR, improvements in quality of care may be small. However, a reason they also found clinical support decision may not improve care as clinicians must agree the behaviors clinical decision support facilitates are desirable. Also support decisions must fit well into the clinical work flow. A weakness of the study was it included only users of a single, particular EMR. While EMRs might not result in large improvements in quality of care, it is important that EMRs are implemented in a manner that fits well into the clinical workflow of primary care offices.

Using an EMR can help adherence to a guideline or program. A standardized DVT risk assessment program developed and incorporated into the EMR for surgical patients (n=800) at the Jesse Brown Veterans Affairs Medical Center. The risk assessment program that utilized the EMR to assess for risk of deep vein thrombosis found that implementation of the program in the

electronic medical record significantly increased use of prophylaxis before surgery (Novis, Havelka, Ostrowski, Levin, Blum-Eisa, Prystowsky & Kibble, 2009). Creation and implementation of a standardized DVT risk assessment program in the EMR significantly increased use of pharmacological and mechanical DVT prophylaxis before surgery. Overall, this finding illustrated the use of an EMR to aid compliance to a program.

It would be expected that similar results may occur for use of triggers. Triggers are clinical decision support tools used in an EMR. Saftan, Rind, Davis, Ives, Sands, Currier, Slack, Cotton & Makadon (1996) did a controlled prospective nonrandomized study of the effect of electronic rules and reminders on adherence to clinical practice guidelines. Physicians and nurse practitioners (n=126) were studied. Presentation of a set of alerts and reminders as part of an EMR resulted in significantly faster and more complete adoption of practice guidelines. The effect was more pronounced with alerts than with reminders. Electronic knowledge-based medical record was effective in helping clinicians adhere to practice guidelines.

Triggers may also help reduce errors. For example, clinical decision support may decrease prescribing errors (Xiao, Sitting, Ash, Sharma, Pang & Middleton, 2011). Xiao et al (2011) outlined the rationale for designing an EMR with extensibility, inoperability and decision support functionality in a concept model/approach to build an EMR model and demonstrated its application to the recording of methadone treatment. A set of archetypes was designed in line with current best practice and clinical guidelines, which guide the information-gathering process. The authors concluded decision support can facilitate the move from observation to evaluation and then to prescribing instruction and action. Automatic decision support could potentially provide valuable integrated support to the clinical process of prescribing and treatment. Their paper embraced the data an EMR can access to use to adhere to guidelines.

Studies also found that EMR triggers need to be implemented in a way that did not drastically change physician behaviors or hinder work flow (Gill et al, 2011; Schriger, Baraff, Buller, Hendrikar, Nagda, Lin, Mikulich & Cretin, 1999). In a busy clinical setting, providers need to be efficient with their time. In Gill et al's (2011) study (previously described) the most common reason cited for disrupting work flow was that triggers took too much time during patient visits. In addition, these authors concluded that clinicians must agree behaviors clinical decision supports facilitate are desirable, also support must fit well into the clinical work flow. When triggers are integrated into the workflow, compliance to clinical guidelines has the potential to be successful (White & Roudsair, 2011). In a study of the design and implementation of a computerized detection and reminder system for asthma care in the pediatric ED, White & Roudsair (2011) found it is possible to leverage different information technology application to create an integrated approach for an asthma reminder system. However, user-driven development created a workflow-suitable approach that supported the acceptance among the busy ED clinicians. In an ideal setting, a user-driven development of a trigger in the EMR would create a workflow-suitable approach (Dexheimer, Arnold, Abramo &Aronsky, 2009).

Rollman et al (1999) described an approach to disseminate an evidence-based depression treatment guideline to primary care physicians using a commercially available EMR system. The EMR offered critical efficiencies in disseminating practice guidelines and in directing the physician's use of them. But they concluded well-designed, randomized controlled trials are necessary to demonstrate EMR effectiveness at enhancing patient outcomes. Overall, clinical practice guidelines offer the opportunity to improve the quality of care, but computer-based guidelines must be accepted by the clinician, be timely, and require minimal additional data entry (Rollman et al, 1999).

Although the EMR can only offer the decision support, providers and clinicians need to be willing to follow the guidelines. Several of the studies in the literature review discussed this issue. Schriger et al. studied febrile children (n=830) less than 3 years of age and the physicians who treated them in a prospective off-on-off interrupted time series experiment conducted in three phases. In the baseline phase, care proceeded in the usually way with handwritten medical records. During the intervention phase, physicians were asked to use EMR when treating febrile children, and in the post intervention control phase, the EMR was removed and handwritten charts were again used exclusively. The use of an EMR and guidelines improved documentation of the medical record and after-care instructions, but the EMR use did not produce substantial or significant changes in physician test ordering or treatment decision-making. It was determined that the willingness of a physician to follow the guidelines was inversely proportional to the annoyance of using and EMR. Other studies agreed that education of clinicians regarding the use of trigger could improve compliance (Baer, Henry, Lambert, Stoddard, Wiedmeier, Eggert, Ilstrup & Christensen, 2011; O'Connor & Pronk, 1998). Baer et al (2011), did a pre-post analysis of compliance with transfusion guidelines and transfusion usage and found that after implementing a system wide program to improve compliance with transfusion guidelines in NICUs (n=4) compliance increased from 65% to 90%.

In addition to studies that found positive outcomes related to EMR support, there were studies that found using EMR clinical decision support or triggers had little or no effect on intended results. In a previously described study, Schriger et al (1999) also concluded implementation of an electronic medical record providing real-time advice and recommendations had little effect on the appropriateness of care, and had no effect on charges. Characteristics of providers must be acknowledged and accommodated if an intervention is to successfully change

behaviors. A study that evaluated the impact of delivering black-box warnings (BBWs) alerts about interactions for prescription medications in outpatients in an EMR with clinical decision support was conducted in outpatient practices (n=51) in the greater Boston area (Yu, Seger, Lasser, Karson, Fiskio, Seger, & Bates, 2011). They compared the frequency of non-adherence to all BBWs abut drug-drug, drug-disease, and drug-laboratory interactions for 30 drug/drug classes, and by individual drugs/drug groups with BBWs between the pre- and post-intervention periods using multivariate analysis to identify independent risk factors for non-adherence to BBWs. The EMR generated alerts using information from the patient's active medication list, problem list, and laboratory results, and applied logic rules to identify potential contraindications. The implementation of BBW-related alerts as advanced decision support for electronic prescribing in the EMR had impact on improvement of the overall BBW adherence rate, although modest improvement for specific subcategories was observed. More advances systems with better decision support should be beneficial in outpatients.

Conclusion of use of Electronic Medical Records Reminders

Electronic medical records (EMRs) open new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. Most studies reviewed in the literature search concluded that implementation of a decision making tool, such as a reminder, resulted in improved patient outcomes. The reminder systems or tool support a guideline based on the individual articles clinical area. In most cases the implementation of the tool was found to be a usable and useful clinical decision support system. Management guidelines are driving the practices of medicine and strong evidence from these articles show adherence to guidelines increase favorable outcomes for patients. Although there were limited studies found that applied to the independent study project content, the results were convincing

that decision support tools do enhance clinicians' decision-making capacity. There is still, however, a lack of complete understanding of clinical decision-making processes of health professionals. This area needs immediate attention so implementation of effective decision support tools such as trigger can succeed in improving patient outcomes.

The first practice recommendation based on the literature search findings would be to implement a computerized tool to trigger clinicians to order HbA1c in a patient that is determined to be prediabetic or has increased risk factors such as being Native American (Novis et al, 2009; Das et al, 2011; Gill et al, 2011) . To implement the practice recommendation a trigger would first need to be set in an EMR based on the manufactures settings. The trigger would look for a diagnosis of prediabetes or risk factor of Native American and would trigger to order HbA1c according to ADA recommendations. Education of the clinicians would be necessary to both inform them of the trigger and the recommendations of the results. Clinicians would then need to refer to a diabetes prevention program if necessary and would need to be educated on the reason for the need of such programs. If the EMR supports triggers, there would be no additional computer or budget involvement.

Triggers could be set to remind providers in primary care clinic settings to order HbA1c as recommended by the ADA to monitor those at risk to develop type 2 diabetes. Presentation of triggers and reminders as part of an EMR can result in significantly faster and more complete implementation of practice guidelines by clinicians (Schriger et. al, 1999; Baer et al, 2011; O'Connor & Pronk, 1998). A computerized tool such as a trigger can lead to an increase in appropriate interventions (Schriger et. al, 1999; Baer et al, 2011; O'Connor & Pronk, 1998; Xiao et al., 2011. A trigger to order HbA1c in a prediabetic patient assists in monitoring the patient's risk to develop type 2 diabetes. Triggers can enhance decision-making by providing education to

clinicians and opportunities to implement an overlooked therapy, intervention, or guideline, and aids the clinician in adhering to nationally accepted guidelines (Schriger et. al, 1999; Baer et al, 2011; O'Connor & Pronk, 1998).

In conclusion, the evidence suggests that decision support tools do improve clinicians' decision making ability (Novis et al, 2009; Das et al, 2011; Gill et al, 2011). Implementation of triggers to remind clinicians to order HbA1c in adult Native Americans, a risk factor for diabetes, can help clinicians refer patient to diabetic prevention programs if necessary and to monitor their prediabetes.

Adult Learning Theory

This independent study project created a learning event, a clinic in-service, using Adult Learning Theory as a framework for the presentation. Adult learning theory has been applied to learning experiences for adults in many trials, articles and research. Often the theory has been used in training situations, patient teaching, and medical schools. Adult learning theory provides a framework and using the characteristics of adult learners, guides the instructor to appropriate teaching strategies. The review of literature that follows illustrated examples of effective use of the theory in education and simulation (Das, Malick & Khan, 2008; Elisha, 2008; Hohler, 2003; Goldman, 2009; Green & Ellis, 1997; Kaufman, 2003; Malick, Das &Khan, 2008; Merriam, 2008; Nelson, 1999; Regan-Smith, 1998; Roberts, Gustavs & Mack, 2011; Russell, 2006). It was also found to be useful for interprofessional learning (Freeman, Wright& Lindquist, 2010; Hean, Craddock, Hammick & Hammick, 2012). Finally, teaching strategies using adult learning theory techniques were found in the literature to aid the learning experience (Zigmont et al., 2011; Clappper, 2010)

Adult learners need to know the relevance of what the need to learn before undertaking to learn it (Knowles, 1990; Kaufman, 2003). The content should be presented to the learner in a way that is applicable their needs. Green (1997) studied second and third year internal medicine residents at a University-based primary care internal medicine residency program (*n=34*) using a pretest-posttest controlled trial to implement an evidence-based curriculum. The educational strategy listed in the study included tutorial actual clinical experiences, resident selection of cases and clinical questions, a variety of resources, and one-on-one faculty opportunities. The effectiveness of the curriculum was associated to the fidelity to adult learning theory. Green concluded the residents took responsibility for their learning when they understood why they needed to learn something and linked their readiness to learn with the need of real life situations. Residents in Green's (1997) study found education strategies based on adult learning theory helped residents understand why they need to learn something and take responsibility for their learning.

Adults accumulate a greater volume of experience, which represents a rich resource for learning and necessitates individualization of learning strategies (Knowles, 1990; Kaufman, 2003). Adults' previous experience must be respected and built upon (Bryan, Kreuter, & Brownson, 2008). Adult learning theory proposes that adults are self-directed learners, having rich experiences and knowledge on which to draw, desire to apply learning to "real world", and see education as a process that increases competence and leads to achievement of their full potential (Hohler, 2003; Das, Malick & Khan, 2008). Das, et al. (2008) wrote a two-part series on tips for teaching evidence-based medicine using adult learning theory. The assumption that underpins this work is that because medical trainees are responsible adults, adult learning theory principles are applicable. Professional development must be structured to provide support from

peers and to reduce the fear of judgment during learning (Das, et al.,2008). The authors concluded that post-graduate learning tends to be driven by self-motivation and relevance to clinical practice.

Principles of adult learning were found as underpinnings for the education of new employees (Hohler, 2003). Hohler (2003) shared strategies used in this type of program in a healthcare center. Strategies included were intended to create an environment in which new staff members feel accepted. This important effort aligns with Knowles' recommendation for creating an environment of mutual trust and respect principle and it also made use of learners' experience by recognizing the nursing knowledge and experience brought by each preceptee. Preceptees were allowed to perform a small portion of each procedure assigned to allow active participation in the learning process. Finally, verbal and written evaluations provided a sense of progress toward goals (Hohler, 2003).

Additionally, adults become ready to learn things when they need to know them (Knowles, 1990; Kaufman, 2003). Nelson discussed the use of adult learning principles for perioperative orientation programs (1999). Nelson's review of the literature showed that the principles of adult learning were effective in a quality perioperative orientation program. The review also suggested a framework that staff developers and nurse managers can use to create or revise a perioperative nurse orientation program. Her findings indicated evaluations determine the effectiveness of the training method. Also, self-study or self- directed learning allows nurses to learn at their own pace and take responsibility for their education. Learning objectives must be specific to the content and to the outcome behaviors expected in the clinical setting. Finally, adult learning principles allow a procedure for self-evaluation of learning needs in which preceptors assist new nurses in assessing their progress toward the educational goals and their

current level of competency. Findings indicated evaluations determine the effectiveness of the training method and self-study or self- directed learning allows nurses to learn at their own pace and take responsibility for their education (Nelson, 1999).

Elisha (2008) looked to see if providing education for certified registered nurse anesthetist clinical educators (CRNACE) would change their beliefs about clinical education and adult learners. The study surveyed nurse educators (*N=33 CRNACE*) using a pretest-posttest controlled trial. According to Elisha no studies of this type have been published in the medical, nursing or nurse anesthesia literature. Therefore an original questionnaire was created to measure change in the perceived behavior and the perceived knowledge of participants. The questionnaire was given to the participants before, immediately after, and 2 months following instruction. Elisha discovered that adult learning principle, along with creating positive teacher-learner relationships, providing positive feedback and conducting student evaluation had the most significant impact on the perceived behaviors of CRNACE (2008). She also found that following the educational offering, the overall quality and quantity of the written responses greatly improved and the participants' level of comprehension increased. Overall Elisha concluded, "the use of adult learning techniques enhances the learner's ability to retain information as it is more meaningful and applicable to practice" (2008, p292).

Adult learning theory is also associated with interprofessional education (Hean, Graddock, Hammick & Hammick, 2012). Two articles that were reviewed discussed adult learning theory and interprofessional learning. Freeman, Wright, & Lindquist (2010) described a facilitator training program for interprofessional learning in a higher education setting. In the program students from nine different pre-registration healthcare programs worked together in small groups to foster the knowledge, skills, attitudes and behavior necessary for effective

interprofessional team working. Facilitated interaction between students in multiprofessional groups was found to be a key element of the interprofessional learning process. Although adult learners prefer to learn in a particular way, the participants in the program were encouraged to engage in other learning styles to ensure they can effectively support the learning in their groups. The research found that reflecting and sharing in small-group work can lead to understanding when the adult learner is actively engaged (Freenan, et al., 2010). Likewise, Hean, Craddock, Hammick & Hammick (2012) presented a guide to discuss how theory can be used to articulate and understand practice through use of a case study approach. They found successful application of adult learning theory to be a key mechanism for well-received interprofessional education. Adult learning theory illuminates the crucial role of facilitators for effectively enhancing student learning and also encourages students to move through a series of developmental stages to achieve transformative learning toward the highest potential for understanding.

Several articles were reviewed to incorporate teaching strategies using adult learning theory. Opportunities must be built into professional development activities that allow the learner to practice what they have learned and then receive structured, helpful feedback (Das, Malick & Khan, 2008). Learning in groups is used in many settings (Imel, 2001). Cooperative learning results in better learning outcomes and group learning motivates participants to become actively involved and engaged in the learning process (Imel, 2001). According to Das et al. (2008) adults need to participate in small group activities during learning to move them beyond understanding to application, analysis, synthesis and evaluation. Small group activities provide an opportunity to share, reflect and generalize learning experiences. Cooperative learning results in better learning outcomes and group learning motivates participants to become actively involved and engaged in the learning process.

Simulation is another strategy, which allows clinicians to learn, practice, and gain experience in a safe and structured environment without risk to the patients (Zigmont, Kappus, & Sudikoff, 2011). Both Zigmont et al. (2011) and Clapper (2010) discussed the use of adult learning theory applied to simulation to enhance learning. Clapper's article explored the way that adult learners perceive learning and reach understanding of clinical expertise. Adult learners may bring both positive and negative frames of reference to the learning environment. Facilitators of learning should select strategies that will allow the learners to become more actively engaged with the construction of their learning and avoid passive teaching strategies. According to adult learning theory, this application of prior knowledge can lead to a good or bad learning experience with the simulation.. Zigmont et al. (2011) also discussed simulation as a powerful educational tool to help facilitate learning for clinicians and change their practice to improve patient outcomes and safety.

Educators need to consider individuals, their experiences and their environment to promote effective life-long learning. Adult learners may bring both positive and negative frames of reference to the learning environment. Facilitators of learning should select strategies that will allow the learners to become more actively engaged with the construction of their learning and avoid passive teaching strategies. According to adult learning theory, this application of prior knowledge can lead to a good or bad learning experience with the simulation. Reflection is often part of simulation and is a method to help leaners reflect on their own learning experience (Zigmont et al, 2011). Simulation as a powerful educational tool to help facilitate learning for clinicians and change their practice to improve patient outcomes and safety (Zigmont et al.,2011). Educators need to consider individuals, their experiences and their environment to promote effective life-long learning.

Conclusion of Adult Learning Theory

Using adult learning theory as a framework for the in-service should be based on the principles laid out by founder Malcom Knowles. The principles as describes by Knowles and Kaufman are thoroughly discussed, studied and used for curriculum: Adult learners need to know the relevance of what they need to learn before undertaking to learn it (Nelson, 1999; Elisha 2008). Adults prefer to take responsibility for their decisions and desire to be viewed as capable of self-direction. Adults accumulate experience, which represents a rich resource for learning and necessitates individualization of learning strategies (Bryan, Kreuter, & Brownson, 2008). Adults become ready to learn when they need the particular knowledge in order to cope effectively with real life situations. Adults have task-centered orientation to learning. Adult students work collaboratively and in dialogue with others developing mutual trust and respect to shape and deepen understanding, knowledge and experience of others should be recognized (Hohler, 2003). While adults are responsive to external motivators, their most potent motivators are internal. It is important understand adult learning to have effective learning outcomes for the clinicians (Knowles, 1990; Kaufman, 2003). They will commit to learning when the goals and objectives are considered realistic and important to them and should be actively involved in the learning process (Das, Malick & Khan, 2008; Bryan, Kreuter, & Brownson, 2008).

Facilitated interaction between students in multiprofessional groups was found to be a key element of the interprofessional learning process (Freeman et al, 2010; Hean et al, 2012). Opportunities must be built into professional development activities that allow the learner to practice what they have learned and then receive structured, helpful feedback (Das, Malick & Khan, 2008). The research found that reflecting and sharing in small-group work can lead to understanding when the adult learner is actively engaged (Freeman, Wright, & Lindquist, 2010;

Imel, 2001). Other successful teaching methods in adult learning include simulation and case studies (Hean et al, 2012; Freeman et al, 2010).

Chapter III

Methods

Introduction.

EMRs are becoming elemental in primary care clinic settings (Holroyd-Leduc et al, 2011). They open new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. The project is an in-service for clinicians at the Menominee Tribal Clinic discussing implementation of triggers in the EMR to help identify patients at increased risk to develop diabetes. Continuing education on best practices and uses of EMRs are needed for clinicians in a clinic setting. The in-service was developed using the principles of adult learning theory and included activities as well as didactic lecture. Content for the in-service comes from a literature review that sought to determine if clinical support can aid clinicians. The in-service was provided to users of the EMRs that would use the triggers. The literature review also found clinicians need to be willing to follow guidelines, the education discussed the guidelines the trigger follows, as well as how to use the EMR to effectively use triggers (Schriger et. al, 1999; Baer et al, 2011; O'Connor et al, 1998).

Target audience.

The target audience was clinicians, including physicians, advanced practice nurses, registered nurses, practical nurses and medical assistants in a family practice care setting. The group is a multiprofessional team, therefore, interprofessional learning is expected. Adult learning theory, has tended to be the theory most often associated with interprofessional education (Hean, Graddock, Hammick & Hammick, 2012) and is therefore applicable in-service setting.

Methodology.

Adult learning theory proposes that adults are self-directed learners, having rich experiences and knowledge on which to draw, desire to apply learning to "real world", and see education as a process that increases competence and leads to achievement of their full potential (Hohler, 2003; Das, Malick & Khan, 2008; Russel, 2006). Previous knowledge of EMRs, triggers, clinical support systems and clinical guidelines are acknowledged and fostered in this educational in-service. They will commit to learning when the goals and objectives are considered realistic and important to them and should be actively involved in the learning process (Das, Malick & Khan, 2008; Bryan, Kreuter, & Brownson, 2008).

The in-service took advantage of the learning opportunities of groups. Cooperative learning results in better outcomes and motivates participants to become actively involved and engaged in the learning process (Imel, 2001). Small group activities provide an opportunity to share, reflect and generalize learning experiences (Das et al, 2008). The in-service was provided at two different times and dates, this allowed for a smaller group per session as well as uninterrupted service in the clinic.

Adult learning theory applied to simulation can enhance learning (Zigmont et al, 2011; Clapper, 2010). It can be a powerful educational tool to help facilitate learning for clinicians and change their practice (Zigmont et al, 2011). A brief demonstration of the use of the trigger in the current EMR was done. Following that an opportunity to participate in a simulation of use of triggers was available to learners.

Course

Learning Objectives

At the conclusion of the in-service the learner will be able to:

- Explain the importance of HbA1c monitoring in prediabetes (affective domain)
- Identify uses of clinical decision support in EMRs (cognitive domain)
- Demonstrate application of a trigger (psychomotor domain)

Content

- Native American risk to develop type 2 diabetes
- Prediabetes
- HbA1c as a primary diagnostic test for diabetes
- EMR
- Clinical decision support triggers
- Trigger implementation
- Work flow

Adult learners need to know the relevance of what they need to learn before engaging in the content (Nelson, 1999; Elisha 2008). The in-service will begin with information on Native Americans and their increased risk to develop type 2 diabetes. The clinic serves primarily Native Americans. Native American adults are diagnosed with diabetes almost twice as often as non-hispanic whites (NCCDPHP, 2011). This fact will provide the significance of the content discussing prediabetes. Prediabetes should be monitored for advancement to diabetes yearly (ADA, 2011). Next the content will cover using HbA1c as a diagnostic test and monitoring or referring as needed based on recommendations by the ADA. This introductory information on the purpose for using triggers in the EMR follows the adult learning principle of motivation. While adults are responsive to some external motivators, their most potent motivators are internal (Knowles, 1990; Kaufman, 2003). The participants will commit to learning when the goals and objectives are considered realistic and important to them and should be actively

involved in the learning process (Das, Malick & Khan, 2008; Bryan, Kreuter, & Brownson, 2008). Adult learners need to know the relevance of what the need to learn before undertaking to learn it (Knowles, 1990; Kaufman, 2003). Adults need to know why they are learning (Bryan, Kreuter, & Brownson, 2008). The main content of the presentation is the use of triggers in the EMR. The trigger would look for a diagnosis of prediabetes or risk factor of Native American and would trigger to order HbA1c according to ADA recommendations. Clinical decision support systems are intended to aid clinician decision making during the process of care (Wrightet al, 2009) and this would be covered as well.

The final information presented to the learners is that of integrating the triggers into the current work flow at the clinic. In Gill et al's (2011) study the most common reason cited for disrupting work flow was that it takes too much time during patient visits. However, when triggers are integrated into the workflow, compliance to clinical guidelines has the potential to be successful (White & Roudsair, 2011). In an ideal setting, a user-driven development would create a workflow suitable approach (Dexheimer, et al, 2009). However in the clinic for the project, an existing EMR is used. Therefore, it would be suggested to use ancillary staff such as nurses or medical assistants to first review charts and implement triggers via a protocol or alert the provider of the need. This could take burden off the provider and allow the provider to focus on the patient during the clinic visit. This also allows the nurse or medical assistant to work more effectively and at a higher level for their licensure or certification. Therefore, suggested work flow is discussed in the presentation in multiprofessional groups.

Evaluation plan.

Adult learning theory should drive the evaluation process. Roberts, Gustavs, & Mack (2011) describe assessment methods based on principles of adult learning. Work-based

assessment tools such as the Mini-Clinical Evaluation Exercise (Mini-CEX), Direct Observation of Procedural Skills (DOPS), 360° feedback and portfolio provide trainees with insight to their performance (Roberts et. al, 2011). DOPS provides structured feedback on performance using a rating scale. This allows for clear, objective feedback. The 360° feedback provides feedback to trainees into their professional and clinical behaviors and provides strengths and weaknesses. Therefore, and adaptation of the DOPS was done to provide an assessment of learning in the clinicians after the in-service. The instructor grades defined tasks against a rating scale, which allowed for clear, quick, feedback to the learner.

During the evaluation, an integration of simulation using the clinic's EMR and a case study is used as a scenario. In the scenario, a detail of the patient's history and presentation is given. The learner then must use the EMR to aid their decision in use of a trigger for an HbA1c order. The learner is rated on a DOPS-like scale. The learner is also encouraged to discuss the rationale for their decisions in the evaluation.

Implications for Nursing Education and Practice

Continuing education on best practices and uses of EMRs are essential for clinicians in a clinic setting. This project offered implications for both nursing practice and nursing education.

Electronic medical records (EMRs) opens new possibilities for integrating knowledge and decision support so that they are readily available to clinicians when needed. EMRs are becoming an integral component of many primary care clinics (Holroyd-Leduc et al, 2011). This is an important consideration for nursing practice. A clinical decision support tool such as a trigger can help nurses adhere to a clinical guideline. Clinical guideline adherence increases favorable outcomes for patients. It is important for nurses to understand the use of EMRs to improve patient care.

Adult learning theory provides an appropriate framework when developing an in-service to staff at a medical facility to create a powerful learning opportunity to achieve a change in practice, such as use of EMR based triggers. Adults learn differently and learning events should be structured as such. Adult learning theory accommodates the characteristics of adult learners and guides the instructor to appropriate teaching strategies and evaluation methods.

Summary

The learning project was developed to determine if using clinical decision support in an EMR can improve patient outcomes. Patient outcomes can be improved with implementation of a decision making tool, such as a reminder based on a clinical guideline, in an EMR. The practice recommendation in the project is to implement a computerized tool to trigger clinicians to order HbA1c in a patient that is determined to be prediabetic or has an increased risk factor such as being a Native American. Education of the clinicians would be needed to both inform them of the trigger and the recommendations of the results. Therefore, an education in-service was developed using adult learning theory as a framework.

The information gained through the development of the content and educational presentation will be disseminated at a future in-service to the medical staff at the Menominee Tribal Clinic. The current EMR at the clinic has the capability to use triggers to help aid providers in reminding them of the need to order HbA1c in at risk patients. It would be hopeful that this in-service would enlighten the staff to the possibilities of the EMR in improving patient outcomes.

References

American Diabetes Association. (2011). Executive Summary: Standards of Medical Care in Diabetes - 2011. *Diabetes Care, 34*(1).

Baer, V., Henry, E., Lambert, D., Stoddard, R., Wiedmeier, S., Eggert, L., Ilstrup, S., & Christensen, Ro. (2011) Implementing a program to improve compliance with neonatal intensive care unit transfusion guidelines was accompanied by a reduction in transfusion rate: a pre-post analysis within a multihospital health care system *Transfusion Practice* 51, 264-269

Bryan, R., Kreuter, M., Brownson, R. (2008) Integrating Adult Learning Principles Into training for Public Health Practice *Health Promotion Practice* 10, 557-563

Clapper, T. (2010) Beyond Knowles: What Those Conducting Simulation Need to Know about Adult Learning Theory *Clinical Simulation in Nursing* 6, e7-e14

Das, K., Malick, S., & Khan, K. (2008) Tips for teaching evidence-based medicine in a clinical setting: lessons from adult learning theory. Part one *J R Soc Med* 101, 493-500

Das, S., Eisenber, L., House, J., Lee, K., Lusk, R., Nielsen, D., Patel, M., Stechiwych, J., & Ermini, E. (2011) Meaningful Use of Electronic Health Records in Otolaryngology: Recommendations from the American Academy of Otolaryngology *Head and Neck Surgery Medical Informatics Committee 144*(135), 135-141

Dexheimer, J., Arnold, D., Abramo, T., & Aronsky, D. (2009) Development of an Athma Management System in a Pediatric Emergency Department *AMIA Symposium Proceedings*,142-146

Diabetes Prevention Program Research Group. (2002). Reduction in the Incidence of type 2 Diabets with Lifestly Intervention or Metformin. *The New England Journal of Medicine, 356*(6), 393-403.

Elisha, S. (2008) An Educational Curriculum Used to Improve the Knowledge and the Perceptions of Certified Registered Nurse Anesthetist Clinical Educators *AANA Journal 76*(4), 287-92

Freeman, S., Wright, A., & Lindquist, S. (2010) Facilitator training for educators involved in interprofessional learning *Journal of Interprofessional Care 24*(4), 375-385

Gill, J., Mainour, A., Koopman, R., Player, M., Everett, C., Chen, Y., Diamond, J., & Lieberman, M. (2011) Impact of EHR-based clinical decision support on adherence to guidelines for patients on NSAIDs: A Randomized Controlled Trial *Annals of Family Medicine 1*(9), 22-30

Goldman, S. (2009) The Educational Kanban: Promoting Effective Self-Directed Adult Learning in Medical Education *Academic Medicine, 84*(7) 927-934

Green, M. & Ellis, P. (1997) Impact of an Evidence-Based Medicine Curriculum Based on Adult Learning Theory *Journal of General Internal Medicine* 12(12), 742-750

Hean, S., Craddock, D., Hammick, M. (2012) Theoretical insights into interprofessional education: AMEE Guide No. 62 *Medical Teacher 34*, e78-e101

Henderson, L. (2010). Divergent Models of Diabetes among American Indian Elders. *Journal of Cross-Cultural Gerontology, 25*, 303-316.

Hohler, S. (2003) Creating an environment conductive to adult learning *AORN Journal 77*(4), 833-835

Holroyd-Leduc, J., Lorenzetti, D., Straus, S., Sykes, L., & Quan, H. (2011) The impact of the electronic medical record on structure, process, and outcomes within primary care: a systematic review of the evidence. *Journal of the American Medical Informatics Association 18*(6), 732-737

Imel, S.(2001)Using Groups in Adult Learning: Theory and Practice *The Journal of Continuing Education in the Health Professions* 19, 64-61

Institute of Medicine Committe on Quality of Health Care in America(2001). *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC

Kaufman, D. (2003) Applying educational theory in practice *British Journal of Medicine* 326(7382), 213-216

Knowles, M. (1990) The adult learner: A neglected species. Houston, TX: Gulf Publishing

Lieb, S. (1991) Principles of Adult Learning *VISION*, Fall 1991

Mateo, M., & Kirchhoff, K. (2009). *Research for Advanced Practice Nurses.* New York: Springer Publishing Company.

Merriam, S. (2008) Adult Learning Theory for the Twenty-First Century *New Directions for Adult and Continuing Education, 119*, 93-98

National Center for Chronic Disease Prevention and Health Promotion. (2011). *Fast Facts on Diabetes.*

Nelson, F., (1999) Using Adult Learning Principles for Perioperative Orientation Programs *AORN Journal 70*(6) 1046-1058

Novis, S., Havelka, G., Ostrowski, D., Levin, B., Blum-Eisa, L., Prystowsky, J., & Kibbe, M. (2010)Prevention of thromboembolic events in surgical patients through the creation and

implementation of a computerized risk assessment program *Journal of Vascular Surgery* 51(3), 648-654

O'Brien, G. (2004) *Principles of adult learning*. Melbourne, Australia: Southern Health Organization Retrieved from http://www.southernhealth.org.au/cpme/articles/adult_learning.htm

O'Connor, P. & Pronk, N. (1998) Integrating population health concepts, clinical guidelines, and ambulatory medical systems to improve diabetes care *Journal of ambulatory care management* 21 (1) 67-72

Regan-Smith, M. (1998) Teacher' Experiential Learning About Learning *Journal Psychiatry in Medicine*, 28(1), 11-20

Roberts, T., Gustavs, J., & Mack, H. (2011) Becoming an expert: a review of adult learning theory and implications for vocational training in ophthalmology *Clinical and Experimental Ophthalmology*, 1-8

Rollman, B., Gilbert, Tr., Lowe, H., Kapoor, W., & Schulberg, H. (1999) The electronic medical record: its role in disseminating depression guidelines in primary care practice International *Journal of Psychiatry in Medicine 29*(3), 267-286

Roubideaux, Y., Noonan, C., Goldberg, J., Valdez, L., Brown, T., Manson, S., et al. (2008). Relation Between the Level of American Indian and Alaska Native Diabetes Education Program Services and Quality-of-Care Indicators. *American Journal of Public Health, 98*(11), 2079-2085.

Russell, S. (2006) An Overview of Adult-Learning Processes Urologic Nursing, 26(5), 349-370

Saftan, C., Rind, D., Davis, R., Ives, D., Sands, D., Currier, J., Slack, W., Cotton, D., & Makadon, H. (1996) Effects of a knowledge-based electronic patient record on adherence to practice guidelines *MD Computing 13*(1) 55-63

Schriger, D., Baraff, L., Buller, K., hendrikar, M., Nagda, S., Lin, E., Mikulich, V., & Cretin, S. (1999) Implementation of Clinical guidelines via a Computer Charting System: Effect on the care of febrile children less than three years of age *Journal of the American Medical Informatics Association 7*(20), 186-195

White, P & Roudsair, A. (2011) Use of ontologies for monitoring electronic health records for compliance with clinical practice guidelines *International Perspectives in Health Informatics* 162, 103-109

Wright, A., Sittig, D., Ash, J., Sharma, S., Pang, J., & Middleton, B. (2009). Clinical Decision Support Capabilities of Commercially-available Clinical Information Systems. *Journal of the American Medical Informatics Association, 16*(5), 637-644.

Xiao, L., Cousins, G., Courtney, B., Hederman, L., Fahey, T, & Dimitrov, B. (2011) Developing an electronic health record (EHR) for methadone treatment recording and decision support *BMC Medical Informatics & Decision Making 11*(5), 1-10

Yu, D., Seger, D.,Lasser, K., Karson, A., Fiskio, J., Seger, A., & Bates, D. (2011) Impact of implementing alerts about medication black-box warnings in electronic health records *Pharmacoepidemiolgy and Drug Safety,* 20, 192-202

Zigmont, J., Kappus, L., & Sudikoff, S. (2011) Theoretical Foundations of Learning Through Simulation Seminars in Perinatology, 35, 47-51