

IMPROVING HEALTH OUTCOMES BY REDUCING
VITAMIN D DEFICIENCY
IN A RURAL CLINICAL SETTING:
A QUALITY IMPROVEMENT PROJECT

by

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ABSTRACT

Vitamin D deficiency strongly correlates with high morbidity and health risks such as fatigue, mood irregularities, and muscle weakness. As of 2023, there are over one billion people of various ages suffering from vitamin D deficiency (Almuqbil et al 2023). A rural Wyoming clinic lacked a standardized process to screen for vitamin D deficiency, yet the condition is highly prevalent within their patient population. This quality improvement project aimed to implement a standardized vitamin D screening process within the rural Wyoming clinic. Patients were screened and offered a blood draw to obtain their vitamin D levels at each office visit. If applicable, patients were offered vitamin D supplementation. In concurrence with the lab draw, patients were asked to fill out a PHQ-9, GAD-7 and Fatigue Severity Scale (FSS) to track their mood and energy levels. The lab draws and screening questionnaires were repeated after eight weeks of supplementation. Screening for vitamin D deficiency improved from less than 20 percent prior to implementing the standardized process to over 90 percent after eight weeks of implementation. There was no significant correlation between PHQ-9, GAD-7, FSS and vitamin D levels. Eight individuals received the eight-week lab draw and 62 percent of these individuals had optimal vitamin D levels, 70-100mg/dL. The standardized vitamin D screening process was successful in increasing quality and frequency of screening; however, a significant correlation between mood, fatigue, and vitamin D levels was not found.

CHAPTER ONE

INTRODUCTION, BACKGROUND & REVIEW OF THE LITERATURE

Introduction

Vitamin D is an essential, fat-soluble vitamin within the body. Although the recommended dietary allowance for vitamin D varies by age, sex, and life stage, literature supports that vitamin D is essential and plays a crucial role in maintaining overall health and well-being in individuals. Vitamin D is vital to mental health, nerve communication, muscle movement, energy, and bone health. The nutrient, Vitamin D, can be obtained through various means; dietary sources including salmon, egg yolks, cheese and fortified products like milk provide vitamin D. In addition, one of the most natural ways to receive this essential vitamin is through exposure to direct sunlight. In cases where sunlight exposure and dietary intake are insufficient, vitamin D can be acquired through exogenous supplementation.

According to the World Health Organization and supporting literature, vitamin D deficiency can have adverse effects on health. Although vitamin D deficiency is relatively common, with varying prevalence rates depending on variables such as geographical location, dietary habits, and lifestyle, addressing the deficiency is critical to health and wellness. Vitamin D deficiency occurs when an individual has serum levels below 30nmol/L (National Institutes of Health, 2022). Deficiency in vitamin D poses critical risks to an individual's physiological and psychological health. The scientific community is noting that there is a consistent association between low vitamin D levels and higher prevalence of mental health disorders. Almuqbil et al. (2023) explained that vitamin D is crucial in the production of serotonin. Serotonin is essential in regulating moods; therefore, low vitamin D could potentially impair brain function, which

impacts emotional processing and overall mental health. Other studies have concluded that vitamin D is essential in mitochondrial function, which is critical to cellular energy production (Pennisi et al., 2019). A deficiency in vitamin D can lead to the inability to produce energy commonly presenting as an increase in fatigue.

Many individuals are unaware of a vitamin D deficiency for years prior to a healthcare provider drawing their vitamin D levels. For providers, vitamin D deficiency can often fall to the bottom of the priority list when considering differential diagnoses as it is commonly viewed as less important than prescription medications. Current research shows that adequate vitamin D deficiency is a nation-wide issue. According to Garnham (2022), approximately one billion people within the nation are vitamin D deficient. In the United States, approximately 42 percent of adults and over 70 percent of children under the age of 11 are vitamin D deficient (Garnham, 2022). Bringing awareness to vitamin D deficiency may not only initiate treatment, but it may contribute to improvement in physical and psychological health outcomes.

Background

Other than through dietary sources, Vitamin D is primarily obtained through sunlight. When ultraviolet B radiation from the sun interacts with the skin, a series of biochemical reactions is initiated, which leads to the synthesis of vitamin D. However, geographical location, skin pigmentation, and sun exposure prevention influences the body's ability to utilize vitamin D; therefore, reducing its health benefits.

Vitamin D is a fat-soluble vitamin that can be obtained through diet, sunlight, and/or oral and cutaneous supplementation. Foods such as liver, salmon, and eggs have gained prominence as additional and alternative ways of acquiring vitamin D; however, studies are discovering that

these recommended dietary sources contain only a moderate amount of vitamin D and may therefore not be meeting the body's needs.

Vitamin D deficiency was originally discovered in the 1600's through the first cases of rickets in children and osteomalacia in adults. As of 2023, there are over one billion people of various ages suffering from vitamin D deficiency (Almuqbil et al 2023). Vitamin D levels are measured in nanograms per milliliter (nmol/L). According to the National Institutes of Health (2022), vitamin D deficiency is defined as levels below 30 nmol/L. Contrary, vitamin D levels above 125nmol/L have been shown to cause health problems and place an individual at risk for vitamin D toxicity. The National Institute of Health (2022) reports vitamin D levels of 50nmol/L to 100nmol/L are sufficient for overall health. Latitude, time of day, and season play a key role in the risk for vitamin D deficiency. Individuals in the northern latitude have a lower exposure to ultraviolet light and experience prolonged periods of spring and winter, which decrease the opportunity for vitamin D synthesis.

Current data supports that low vitamin D levels strongly correlate with higher morbidity and health risks. The consequences of vitamin D deficiency can range from mild symptoms such as fatigue, a common sign associated with a vitamin D deficit and muscle weakness to more severe complications such as a decline in mental health.

Proposed Solution

A standardized, evidence-based screening process for vitamin D deficiency needs to be implemented. This process improvement will standardize screening in the selected patient population and provide an opportunity for patient education, serum vitamin D levels to be drawn, and vitamin replacement as necessary. Every patient will be screened at their provider office visit

or annual exam. If applicable and consensual, a wellness lab drawn, including a serum vitamin D level, will be drawn. The patient's serum vitamin D levels will be one dependent variable, but their mental health status and level of fatigue will also be evaluated. This evaluation will occur prior to the protocol being implemented as well as after using a standardized screening tool.

Methods

Overview of Literature Search

A literature search was conducted in an effort to obtain evidence showing the relationship between vitamin D deficiency and mental health status as well as levels of energy. Thereafter, literature was gathered on the most recent vitamin D deficiency treatment protocols. This material was gathered and evaluated to create an updated, evidence-based, protocol to implement at a private practice.

Search Strategy

An initial review using ProQuest was conducted using the search terms "vitamin D," "treatments," "deficiency," and "vitamin D and fatigue/mental health." This search yielded over 2,000 articles. Further narrowing the search was developed through limiting the articles to September 2018 to September 2023, selecting English only articles, and articles were limited to peer reviewed and full text articles only. There were 196 articles after this refinement. 53 additional articles were obtained from other sources. After duplicate articles were eliminated 187 remained. 79 articles were then screened, and 12 articles were obtained for the review of literature.

PRISMA

See Appendix A

Results

Quantitative

Eleven articles were selected for review. Seven of the articles were quantitative while three were qualitative. Five of the seven quantitative articles were designed as randomized controlled trials while two were cross sectional studies. The three qualitative articles were systematic reviews of previously published literature. Three articles were graded as level one evidence literature while five were a level two and two were level four evidence.

Synthesis of Literature

Vitamin D controls neurological pathways within the brain and therefore plays a role in psychological and physiological function (Almuqbil et al, 2023, p. 1). It is required for optimal cellular performance throughout the body. Newfound understanding of the benefits of vitamin D and its role on health and well-being has encouraged further discussion on the potential therapeutic use of vitamin D in the context of anxiety, depression, and fatigue. The following discussion presents a synthesis of literature that is aimed to present the link between vitamin D and overall well-being. It aims to unravel the underlying connection between vitamin D and a decrease in mental health and fatigue. The discussion will explore avenues for prevention of psychological and physiological disorders and explore avenues for prevention and intervention through vitamin D therapy.

Mental Health. Recent research has unveiled a correlation between vitamin D deficiency and mental health illnesses. Although initially, vitamin D was primarily linked to bone health, it is increasingly gaining momentum and recognition in its wide range of effects, namely, receptor sites such as the brain. The scientific community is noting that there is a consistent association between low vitamin D levels and higher prevalence of mental health disorders (Pennisi et al., 2019).

Pennisi et al. (2019), explained in their study of the effects of vitamin D on mental health that receptors are present in the areas of the brain that involve the regulation of moods. Vitamin D plays a role in the production of serotonin, which is essential to mood regulation and neurological processes. Vitamin D is involved in neuroplasticity; therefore, a deficiency in Vitamin D could potentially impair brain function affecting emotional processing and regulation, which could lead to impaired mental health.

Pennisi et al. (2019) found an inverse relationship between vitamin D levels and anxiety symptoms due to vitamin D's influence on neurotransmitters and the neuroinflammatory process. Kouba et al. (2022) support Pennisi et al. (2019) by claiming that vitamin D is known to have anti-inflammatory properties. Furthermore, they purport that chronic inflammation has been linked to vitamin D deficiency and may actually exacerbate an inflammatory response, which could contribute to mental health conditions.

The potential effects of vitamin D supplementation remain controversial. In a study conducted by Kouba et al. (2022), the supplementation of vitamin D showed significant improvement in anxiety, but not in symptoms of depression. While there is compelling body of evidence that connects altered mood and low levels of vitamin D, it is important to note that

although many of the discussions signify the correlation between maintaining adequate levels of vitamin D to improve moods, more research needs to be done to prove causation (Pennisi et al., 2019).

Fatigue. Fatigue has been associated with compromised health outcomes and is a common complaint of individuals. Although initially vitamin D gained recognition for its benefits in skeletal integrity, further discussion has shown that vitamin D receptors are present in skeletal muscles therefore, it was concluded that vitamin D plays a role in muscle function (Amanyuan et al., 2021). A discussion by Pludowski (2023) supports this claim as the study noted vitamin D improves the body's absorption of calcium, which is necessary for muscle strength and a reduction in fatigue. Considering the research conducted by Amanyuan et al. (2021) and Pludowski (2023), it was concluded that deficient levels of vitamin D led to muscle weakness, contributing to fatigue.

Similarly, to Amanyuan et al.'s (2021) and Pludowski et al.'s (2023) findings, Apaydin et al. (2018) studied the treatments levels of vitamin D and muscle strength in postmenopausal women. The evidence of their study suggested that low vitamin D levels have been linked to a decrease in musculoskeletal performance. Further studies like that of Pennisi et al. (2019), noted that vitamin D is believed to influence mitochondrial function, which is critical to cellular function and energy production. Based on the findings of Pennisi et al. (2019), impaired mitochondrial function may result in reduced levels of energy and increased fatigue.

Treatment. Fifteen minutes of surrounded direct sunlight exposure generally provides 10,000 units of vitamin D to the circulation system. This sun exposure has been shown to maintain vitamin D levels within a normal range (Donati et al., 2023). Unfortunately, the ability

to obtain this direct sunlight is often inhibited by working, weather, and clothing; therefore, the prevalence of vitamin D deficiency remains, particularly in northern latitudes and in the winter months. Vitamin D can be supplemented in two main forms: oral and intramuscular. Donati et al. (2023), discusses the absorption of oral vitamin D is good, but not complete. Oral vitamin D can be replaced in the form of cholecalciferol and calcifediol. Calcifediol has been shown to be over 14 percent more readily absorbed in comparison to cholecalciferol. In this case, calcifediol was found to be three times as potent even when the patient had a malabsorption condition (Donati, 2023). Donati (2023) purports that supplementation of 400 to 2000 international units of vitamin D per day is adequate; however, an exact protocol was not devised, and the authors concluded more research would need to be conducted.

Gupta et al., (2017) conducted a randomized controlled trial to compare the efficacy of oral versus intramuscular vitamin D replacement. 40 healthy adults enrolled into this study were placed into two groups: oral and intramuscular vitamin D replacement. The first group was to receive 60,000 international units (IU) of vitamin D weekly for five weeks. There was not a discussion of how this 60,000 IU should be administered throughout the week. The second group received a one-time intramuscular injection of 300,000 IU. This protocol was based upon the National Institute of Health's (2022) recommendation to supplement 50,000 IU once weekly for eight weeks or 6,000 IU daily for 8 weeks. In both groups, vitamin D levels were measured prior to beginning the protocol, and at six and twelve weeks after the protocol had been completed. In both groups, vitamin D levels improved; however, the group who received intramuscular supplementation had a continued increase from their baseline levels whereas the orally replaced group had a peak followed by a gradual decrease in vitamin D serum levels.

Khan et al., (2021), conducted a similar study and compared the efficacy of parental versus oral vitamin D replacement over a period of six months. Again, a baseline level of vitamin D was established, then the 84 patients participating in the study were split into two groups. The patient protocol education included an expectation for a follow-up lab draw three and six months after completing the protocol. The vitamin D protocol consisted of one group receiving 50,000 IU of oral vitamin D weekly for 12 weeks and the other receiving a once monthly injection of 300,000 IU. Sufficient vitamin D was defined at levels greater than 30 ng/ml. At the three-month lab draw, the oral vitamin D group had a 53 percent increase in levels while the intramuscular group had a 103 percent increase in their levels. At the six-month blood draw the oral vitamin D group had a 79% increase and the intramuscular group had a 207 percent increase. 35 of the patients noted a self-reported improvement in their overall health. Based on the results of this study, both groups experienced a benefit from the supplementation, however the intramuscular protocol proved to have superior outcomes (Khan, 2021).

Apaydin et al., (2018) conducted a study to evaluate the effect vitamin D replacement has on postmenopausal symptoms. Vitamin D deficiency was defined as levels less than 20ng/mL. 60 women qualified for the study and were split into two groups. 32 women received a daily dose of 800 IU of vitamin D while 28 women received a single oral dose of 300,000 IU. Vitamin D levels and muscle strength were measured prior to starting the protocol, at week four of treatment, and week 12 of treatment. Both groups experienced an increase in their serum vitamin D levels; however, the group who received a single dose of vitamin D had a greater initial increase at the four-week lab draw. On the other hand, the single dose group had a decrease in serum vitamin D at the twelve-week lab draw. The group who received the daily dose of vitamin

D had a notable increase in levels as well. Almost half of the patients achieved a level greater than 50nmol/L at twelve weeks and approximately six percent achieved a level greater than 75nmol/L (Apaydin et al., 2018). Isokinetic muscle strength was also assessed using a resistance test to produce a maximum quadricep and hamstring peak torque (Nm) (Apaydin et al., 2018). The single dose group did not have a difference between their baseline, week four, and week twelve muscle testing with p being 0.03 and p greater than 0.05 considered statistically significant. The daily dose group had a significant increase in muscle strength ($p=0.038$) at four weeks and an increase in hamstring strength at week twelve ($p=0.037$).

Discussion and Conclusion

Holistic health and personalized medicine has garnered considerable attention directed on the critical components of vitamin D therapy. As discussed, vitamin D has multifaceted purposes and benefits and plays a powerful role in maintaining health and quality of life. Harnessing the full potential of vitamin D has the potential to serve as a catalyst to treat individuals experiencing or diagnosed with anxiety, depression, and fatigue in conjunction with other therapeutic modalities.

Findings

While the one-time dose injection of vitamin D delivered a significant increase in serum vitamin D levels, this increase was not sustained over a period of time. A daily dose of vitamin D produced a moderate increase in vitamin D levels that was sustained at the follow-up lab draws. In addition, one-time injection is preferable for increasing vitamin D levels quickly, while a daily oral dose of medication is helpful in sustaining and maintaining adequate serum vitamin D.

Implications

A baseline vitamin D level should be obtained prior to the implementation of a protocol. It is recommended that vitamin D should be added to the yearly wellness panel that all patients receive, so routine screening is in place. After the lab draw, patients should be scheduled for a follow-up visit with a provider to review their wellness labs. This will be a fifteen-to-twenty-minute visit that is included in their plan of care. At this visit, the provider will review lab results with the patient and implement the vitamin D protocol if vitamin D levels are below 20nmol/L. The protocol will include two options: parental and oral replacement. The exact protocol will be determined based upon evidence-based literature and preference of the patient. A lab draw will be conducted at four weeks, eight weeks, and twelve weeks to assess the changes in vitamin D levels. This protocol will strive to achieve a goal serum concentration of 50nmol/L to 100nmol/L.

CHAPTER TWO

QUALITY IMPROVEMENT PROPOSAL

Introduction and ProblemIntroduction

Vitamin D, commonly known as the “sunshine supplement,” has gained momentum in recent years for its multifaceted role in promoting and maintaining overall health benefits. Initially, vitamin D gained popularity for its pivotal association in calcium metabolism and bone health. However, recent research has uncovered that the benefits of vitamin D extend far beyond its classic role in skeletal integrity. Recent studies have illuminated vitamin D’s involvement in multiple physiological systems such as improvement in mood, and chronic fatigue. The role of vitamin D and the benefits to a standardized screening process will be discussed.

Problem Statement

Vitamin D deficiency is a widespread health concern with far-reaching implications. The consequences of vitamin D deficiency are manifold, impacting not only bone health, but physical and psychological well-being. The problem is that many people report they are suffering from chronic fatigue and altered mood, yet their vitamin D levels are not being evaluated or treated. This pervasive issue underscores the importance of screening for and maintaining proper level of vitamin D and highlights the need for intervention to mitigate its adverse effects on health.

Clinics and healthcare systems are falling short in addressing the widespread problem of vitamin D deficiency, specifically in the northern latitudes. A primary care clinic in northeastern Wyoming has identified that patients are not consistently having vitamin D screening,

specifically it is not part of the standard wellness draw. Moreover, a vitamin D level is primarily drawn upon patient request or at the provider's discretion, otherwise there is not a protocol in place to evaluate vitamin D levels on every patient at the clinic. This oversight has the potential to lead to delayed diagnoses and missed opportunities for early intervention.

Vitamin D supplementation is offered at the clinic when a deficiency is detected; however, detection is infrequent due to a standardized screening process not being in place. Presently, when patients are detected as vitamin D deficient, they are offered an injection of 100,000 units every three months or a daily supplement of 2,000 units orally. With the current screening process and supplementation protocol, patient's vitamin D levels have remained less than 30ng/dL and patient reports of fatigue, and irregular moods have remained unchanged.

Organizational Microsystem Assessment

The project implementation site is located in rural, northeastern Wyoming. The site is a small private practice serving men and women of all ages. The clinic staff is composed of five nurses, two nurse practitioners, and three front desk personnel. The nurses see approximately 20 patients per day and carry out a variety of tasks: vitamin injections, intravenous infusions, weight management counseling, facials, Botox, vitals, microneedling, lab draws, and other provider assigned duties. The two nurse practitioners see patients for primary care purposes, annual exams, hormone replacement therapy, weight management counseling, medication refills, mental health medication management and some aesthetic services. The front desk personnel are responsible for answering the phone, billing, scheduling, and putting in lab orders.

On average, there are 1,000 patient encounters at this rural clinic every month. In the month of September, there were 897 patient encounters. Less than 20 percent of these patients

had a vitamin D lab draw within the previous six months and of those who had a vitamin D level drawn, 83 percent were noted to have deficient serum levels. The number of vitamin D deficient individuals in this rural clinic is almost double the national average of 42 percent. It is important to note that 80 percent of individual's did not receive a screening for vitamin D deficiency.

Quality Improvement Model

The Replicating Effective Programs Process (REP) was referenced when composing this quality improvement proposal. This framework contains four phases to replicate effective programs: pre-conditions, pre-implementation, maintenance, evolution. The precondition phase includes identifying the problem, composing a potential intervention, and building awareness to potential barriers. The rural clinic in northeastern Wyoming had an identified problem of vitamin D deficiency in their patient population. The identified problem was followed by a proposed solution of standardized screening for vitamin D deficiency. Potential barriers within implementing this project are staff compliance in complying to the screening process and patient's taking the supplementation as prescribed. The second phase within the REP process is pre-implementation. This second phase expands on specific steps of the intervention and identifies key stakeholders. Key stakeholders for this process were the clinic owner, nursing staff, front desk staff, and providers. Within the pre-implementation phase, all staff members will be educated on their specific roles in the protocol implementation. This education will take place during the November monthly staff meeting, and individual follow-up will be provided to those who are unable to attend or require further education. After all staff members have been prepared for implementation, the quality improvement project will be launched. The implementation phase requires continuous evaluation and collection of data. The patient's serum vitamin D levels as

well as their subjective responses to fatigue and mood will be tracked throughout the implementation. At this time, staff may provide feedback on how they would like to improve or modify the new process. The final phase is maintenance and evolution. These are the steps that are taken to sustain the intervention. Financial changes may need to be made to ensure the intervention is economical for long-term practice. In this case, the owner of the practice has approved vitamin D to be added into the yearly wellness panel that is included within the clinic's membership.

Specific Aim and Purpose Statement

The Quality Improvement (QI) initiative aim is to identify and adequately treat vitamin D deficient patients and therefore, decrease associated symptoms such as self-reported fatigue, low mood, and anxiety experienced by patients participating in the protocol. This quality improvement project will aim to improve individual patients physical and psychological well-being through obtaining optimal serum vitamin D levels. Vitamin D levels will be assessed and treated in a comprehensive manner.

Methods

Implementation Summary

The implementation site is a rural clinic in northeastern Wyoming. This site identifies as a holistic wellness clinic for men and women, with a patient population ranging from 20 to 70 years old. To optimize the practice change for improved patient outcomes, there are four necessary steps: educating the stakeholders, preparing questionnaires and consents, implementing the change of practice, and scheduling follow-up visits.

Intervention and Implementation

Any change in practice requires gaining the support of key stakeholders. In this clinic, key stakeholders are the nurses, providers, and front desk staff. All employed personnel are essential in making this practice change. Education will be provided based upon job category.

Nurses. A mood and energy screening form will be gathered by the nurse for the patient to fill out at their lab draw. These documents will be conveniently placed in the patient's folder above the lab station in a packet, so nurses can access them quickly for patients to complete when drawing a wellness panel. The nurses will be responsible for having the patient complete all necessary screening forms prior to their blood being drawn. The nurses will then put the signed screening forms in the chart. A green gel tube will be drawn to obtain a wellness panel, which will include a complete comprehensive panel, lipid panel, thyroid stimulating hormone, and vitamin D level. The selected tests will be circled on a provided lab sheet that is presently used with each lab draw. This lab sheet is given to the front desk personnel, so they can enter the selected labs into the contracted lab for this clinic.

Front Desk Personnel. Front desk personnel will print out the labels and requisition forms that are affiliated with the order. The front desk personnel have a current process of placing the requisition and labels on the back table for nurses to apply to these lab tubes. An additional requisition will be placed into the patient's chart for reference at the 8-week follow-up lab draw. Many of the aforementioned tasks are already in place at the clinic; however, education will be reinforced on the current and new practice changes. The labs will be processed at a Regional Clinic and will result on a Clinic portal within 48 hours. The labs results are printed from the inbox by the front desk staff every morning and are placed in the provider's office to be reviewed

by the nurse practitioners. Currently, all labs are reviewed within 48 hours at the clinic, this process will be continued.

Providers. Providers will be educated on the importance of the protocol to place the patient on based upon the result of their labs. In addition, the written protocol will be placed in the lab review folder for reference and to serve as a reminder to the providers of practice change. Patients who have vitamin D levels less than 30ng/dL, or those who are below 50ng/dL and symptomatic shall be placed on one of two protocols: 10,000 units of oral vitamin D five days per week, or a loading dose of 300,000 units of vitamin D injection one-time (Khan et al., 2021). In addition, the health care providers will be educated to on the permission to deviate from the protocol based on unique needs of the patient. Patients will be educated by the provider that current research shows that injectable vitamin D optimizes vitamin D levels; however, the choice of oral or injectable replacement is at the discretion of the patient. Both of these protocols will be implemented for eight weeks. In other words, the individuals who choose oral replacement will be advised to take 10,000 units five days a week for eight weeks while the individuals who choose injections will be provided with one injection of 300,00 units during the eight-week period. Both protocols are offered at the clinic. Upon implementing the protocol, the provider will make an 8 week follow up lab draw to evaluate the patient's vitamin D level. At this lab draw, the patient will again fill out the three same questionnaires to assess mood and energy levels. This data will be collected and placed into a flow sheet for evaluation. All patients may have the opportunity to decline any treatment offered, either oral supplementation or an IM dose of vitamin D. Furthermore, all patients have the right to not complete the protocol at any time and at their own discretion. Patients with positive screenings for anxiety and depression using the

GAD-7 and PHQ-9 screening tools will be assessed by a provider for a diagnosis and offered appropriate treatment as determined by the provider or referred to specialists outside of the clinic setting.

Effectivity. In the scenario where vitamin D levels are not increased after the protocol, further investigation will need to be conducted. According to the Cleveland Clinic (2022), cystic fibrosis, Crohn's disease, celiac disease, obesity, kidney, and liver disease may impact the absorption of exogenous vitamin D and cause persistent deficiency. Patients who do not experience an increase in their vitamin D level after completion of the protocol will need to have an office visit with one of the nurse practitioners in the rural clinic. This practitioner will consider patient compliance, vitamin D dosage, and underlying medical conditions as these are all common factors that may affect improving vitamin D deficiency.

Risks and Benefits. The two protocols that will be initiated by the practitioner are based upon evidenced-based research and current protocols in other facilities. Potential risks of the protocol will be explained within the consent, which the patient will sign prior to initiating the protocol. There is a rare risk of vitamin D toxicity. Approximately 4,500 individuals are diagnosed with vitamin D toxicity in the United States per year (Cleveland Clinic, 2023). Symptoms of vitamin D toxicity may appear as nausea and vomiting, constipation, dehydration, frequent urination, muscle weakness, lethargy, fatigue, a decrease in appetite. These symptoms are a result of excess calcium within the blood stream, which may result from an excess supplementation of vitamin D (Cleveland Clinic, 2022).

Screening. All of the patients will receive two sets of questionnaires: one at the baseline lab draw and one at the eight-week lab draw. These questionnaires screen for fatigue and mood changes. These interventions will be based upon Table 1: PHQ-9 Treatment Actions per Kroenke et al., (2001). For a result of 5 to 9 or a mild depression screen, patients will repeat the PHQ-9 at the 8-week lab draw. Individuals who have a result greater than 10 will be scheduled a visit with a health care provider at the rural clinic within one week of the screening form being completed.

Table 1. Affiliated depression severity and proposed treatment actions based upon the PHQ-9 score.

Provisional Diagnosis and Proposed Treatment Actions		
PHQ-9 Score	Depression Severity	Proposed Treatment Actions
0 – 4	None-minimal	None
5 – 9	Mild	Watchful waiting; repeat PHQ-9 at follow-up
10 – 14	Moderate	Treatment plan, considering counseling, follow-up and/or pharmacotherapy
15 – 19	Moderately Severe	Active treatment with pharmacotherapy and/or psychotherapy
20 – 27	Severe	Immediate initiation of pharmacotherapy and, if severe impairment or poor response to therapy, expedited referral to a mental health specialist for psychotherapy and/or collaborative management

The GAD-7 will be used to screen for anxiety. According to PAR Staff (2020), a score of 0 to 4 does not require treatment. A score of 5 to 7 requires monitoring and follow-up screening,

which will take place at the eight-week lab draw, where the GAD-7 will be completed again.

Scored 9 to 21 require a visit with a healthcare professional, which we be scheduled within one week of completion of the questionnaire. Table 2: GAD-7 Treatment Recommendations will be a resource for providers when determining interventions for the patients.

Table 2: Anxiety treatment recommendations based upon GAD-7 scoring.

Score	Severity	Recommendations
0-4	None to minimal	No follow-up is warranted at this time.
5-7	Mild	It is recommended to monitor symptoms and follow-up as indicated.
8-9	Mild	This individual is likely to be diagnosed with an anxiety or related disorder. Repeat administration of the GAD-7 every 4 weeks to monitor symptoms. Follow up to determine if current symptoms warrant a mental health professional.
10-14	Moderate	This individual is likely to be diagnosed with an anxiety or related disorder. Their symptoms are clinically significant and warrant further assessment (including diagnostic interview and mental status examination and/or referral to a mental health professional is recommended.
15-21	Severe	This individual's symptoms of anxiety likely warrant active treatment. This individual is likely to be diagnosed with an anxiety or related disorder. Further assessment (including diagnostic interview and mental status examination) and/or referral to a mental health professional is recommended.

Cost. Oral vitamin D replacement will cost the patient \$15.40 for a 60 day supply while the injectable will cost \$26 per injection, so a total of \$52. Patients may use their health insurance as appropriate. The chosen protocol will be dictated within the patient's virtual chart on the current electronic medical record (EMR) Tebra. The owner and key stakeholder of the clinic has agreed to waive the cost of vitamin D lab testing for patients who are unable or unwilling to pay for the lab draw. The owner has also agreed to include vitamin D in the yearly, free wellness panel for all the patients who are members of the clinic. The monthly membership

is \$45 and includes free urgent care visits, 30 percent off products and visits, and a free wellness panel per year.

Evaluation and Analysis

A baseline set of data will be collected. This data will consist of a serum vitamin D level, PHQ-9 score, GAD-7 score, and fatigue severity scale score. The (PHQ-9) and the (GAD-7) will be used to assess mood symptoms. The fatigue severity scale (FSS) will be used to assess the individual's level of fatigue. These screening tools are routinely used at annual exams per national guidelines. According to Pranckeviciene et al., (2022), the PHQ-9 and GAD-7 are effective and reliable screening tools based upon a Cronbach alpha of 0.86 for PHQ-9 and 0.91 of GAD-7. Serum vitamin D levels will be reported in nanograms per milliliter (ng/mL) with less than 30ng/mL signifying an insufficiency and 70 to 100ng/mL signifying optimal vitamin D levels. After patients have participated in the practice change for eight weeks, the aforementioned questionnaires will be repeated: PHQ-9, GAD-7, FSS, and serum vitamin D. All of these test results are reported in a quantitative value and will be compared to the baseline value. Statistical Package for the Social Sciences (SPSS) will be used to analyze the data.

Goals. The initial goal of this quality improvement project is for 100 percent of patients who have an office visit to receive vitamin D screening. A secondary goal is for 100 percent of patients who are deemed vitamin D deficient to be offered the vitamin D replacement protocol. The providers will be responsible for interpreting the lab results, recognizing the deficiency, and offering the vitamin D protocol to every patient. Patients have the right to accept or reject starting supplementation. A final goal is for vitamin D levels to increase to an optimal level of 70 to 100ng/dL at the eight-week lab draw. This goal will be evaluated by the project initiator,

through observing the serum vitamin D levels. Long term, the goal is for this screening process to become standardized, consistent, and aid in improving patient outcome in the future. The achievement of this goal will not be evaluated in the duration of this quality improvement project.

Safety and Confidentiality

Data will be collected on a site computer within the site, which will remain at the site for the duration of the quality improvement project. Vitamin D levels will be obtained from the lab portal, which is only present on the site computer. Prior to starting the new vitamin D protocol, patients will sign a consent form explaining any potential risks as well as a confirmation of confidentiality. At the time of the first blood draw, patients will complete three questionnaires to evaluate their current state of anxiety, depression, and fatigue. These results will be entered into the excel sheet on the computer within the clinical site. This process will be repeated at the eight-week lab draw. Prior to analyzing the data all patient identifiers such as name and date of birth will be removed from the data. The data without identifiers will be analyzed and discussed within the final manuscript

Table 3. SMART Goals

<p>SMART Goal #1: 100% of patients who have an office visit with a nurse practitioner are screened for a vitamin D deficiency</p> <p>Description of Strategies: Providers have been educated of screening process and understand the responsibility of asking patients about their recent blood draw, previous screening for vitamin D, and vitamin D supplementation.</p>		
<p>Data to be collected:</p> <ul style="list-style-type: none"> • Number of office visits and annual exams from December to March • Number of patients screened for vitamin D deficiency at office visit 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Nurse practitioners are responsible for screening • QI project lead will run a report for presence of screening through EMR 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Office visits and presence of screening will be presented in a flowsheet in Excel
<p>SMART Goal #2: 100% of patients who are vitamin D deficient are offered the vitamin D replacement protocol</p> <p>Description of Strategies: The nurse practitioners are responsible for offering the protocol based upon the patient’s lab result. The nurse practitioner will deem the patient vitamin D deficient or sufficient and offer the protocol as they see fit. All patients who are deficient will be offered the protocol and their acceptance or denial of supplementation will be documented by the provider.</p>		
<p>Data to be collected:</p> <ul style="list-style-type: none"> • Number of patients vitamin D deficient • Number of patients who are contacted and offered vitamin D protocol • Number of patients who begin the protocol 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Nurse practitioners are responsible of offering the protocol to patients • QI project lead will run a report on patients who were offered protocol, number accepted, number refused 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Chosen protocol will be tracked in a spreadsheet (PO vs IM) for reference • All questionnaire forms will be placed in patient’s chart for reference and vitamin D scores will be tracked throughout project at baseline and 8 weeks. • Track patient education and offering or protocol in EMR via patient note in “education” section

SMART Goal #3: 100% of patients who received vitamin D replacement will have optimal vitamin D levels (70-100ng/dL) at their 8-week lab draw

Description of Strategies: a vitamin D lab draw will be conducted at baseline per the provider's order. The nurses will be responsible for drawing this lab. Thereafter, if patients accept the supplementation protocol, their labs will be redrawn at eight weeks by the nurses. These results will be analyzed and compared by the QI project initiator and nurse practitioners.

<p>Data to be collected:</p> <ul style="list-style-type: none"> • Vitamin D levels at baseline and 8 weeks 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Collection for Clinic lab site as well as EMR by QI project lead 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Data will be input into excel sheet and SPSS will be used to analyze
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CHAPTER THREE

IMPLEMENTATION OF THE STANDARDIZED VITAMIN D SCREENING PROCESS IN A
RURAL CLINICAL SETTING: QUALITY IMPROVEMENT PROJECT

Contribution of Authors and Co-Authors

Manuscript in Chapter 3

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Contributions: Discovery of clinical problem, conducted analysis of clinical problem, review of literature, developed intervention, implemented intervention, data collection, draft of manuscript

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Contributions: Editorial review, support in development of intervention, formatting advisement, content advisement

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Contributions: Editorial review

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Section 1: Clinical Problem

Current research showed that vitamin D deficiency is a nation-wide issue. In the United States, approximately 42 percent of adults and over 70 percent of children under the age of 11 are vitamin D deficient (Garnham, 2022). These staggering statistics continue to be present in a smaller sample of individuals at a rural clinic in Wyoming where there are approximately 1000 patient encounters every month. In the month of September 2023, there were 897 patient encounters. Less than 20 percent of these patients had a vitamin D lab draw within the last six months and of those who had a vitamin D level drawn, 83 percent were found to be vitamin D deficient. The number of vitamin D deficient individuals in this rural clinic is almost double the national average of 42 percent. Screening for vitamin D deficiency in this rural clinic is infrequent and inconsistent leading to delayed diagnosis and a missed opportunity for early intervention and treatment.

More often than not, vitamin D deficiency is mitigated by vitamin D supplementation. Although the solution seems simple, the problem persists. Screening for vitamin D deficiency often falls at the bottom of the priority list when conducting a general wellness lab draw or considering differentials for a diagnosis. Vitamin D has an instrumental impact on one's bone health, mood, energy, and metabolic function, yet it is rarely ordered when considering diagnostics and treatment regimens for the aforementioned conditions. Implementing a standardized vitamin D screening process is imperative to improving an individual's overall health and well-being.

Section 2: Review of Literature

Gupta et al., (2017) conducted a randomized controlled trial to compare the efficacy of oral versus intramuscular vitamin D replacement. The 40 healthy adults enrolled into this study were placed into two groups: oral and intramuscular vitamin D replacement. The first group was to receive 60,000 international units (IU) oral vitamin D weekly for five weeks. There was not a discussion of how this 60,000 IU should be taken throughout the week. The second group received a one-time intramuscular injection of 300,000 IU. This protocol was based upon the National Institute of Health's (2022) recommendation to supplement 50,000 IU once weekly for eight weeks or 6,000 IU daily for 8 weeks. In both groups, vitamin D levels were measured prior to beginning the protocol, and at six and twelve weeks after the protocol had been completed. In both groups, vitamin D levels improved; however, the group who received intramuscular supplementation had a continued increase from their baseline levels whereas the orally replaced group had a peak and then gradually began to decrease.

Khan et al., (2021), conducted a similar study and compared the efficacy of parental versus oral vitamin D replacement over a period of six months. Again, a baseline level of vitamin D was established, then the 84 patients participating in the study were split into two groups. These patients were educated that they would be having a follow-up lab draw three and six months after completing the protocol. The vitamin D protocol consisted of one group receiving 50,000 IU of oral vitamin D weekly for 12 weeks and the other receiving a once monthly injection of 300,000 IU. Sufficient vitamin D was defined at levels greater than 30 ng/ml. At the three-month lab draw, the oral vitamin D group had a 53 percent increase in levels while the intramuscular group had a 103 percent increase in their levels. At the six-month blood draw the

oral vitamin D group had a 79% increase and the intramuscular group had a 207 percent increase. 35 of the patients noted an improvement in their overall health. Based on the results of this study, both groups experienced a benefit from the supplementation, but the intramuscular protocol proved to be superior (Khan, 2021). There was an absence of vitamin D toxicity in all of the study groups.

Section 3: Conceptual Framework

The Replicating Effective Programs Process (REP) was referenced when conducting this quality improvement proposal. This framework contained four phases to replicate effective programs: pre-conditions, pre-implementation, maintenance, and evolution. Within the precondition phase, vitamin D deficiency among the majority of patients in a rural Wyoming clinic was recognized. A standardized screening process for vitamin D deficiency was proposed and developed. The screening process included obtaining permission from key stakeholders to include a vitamin D level within the wellness lab draw package. This permission was granted, and it was decided that the package of wellness labs would be offered to each patient annually with the option to bill to insurance or self-pay. The clinic owner deemed that this package of labs would be included within the monthly membership fee for the individuals who participated in the membership program.

Within the pre-implementation phase, the owner and all staff members were identified as key stakeholders. Additionally, during this phase all key staff holders were educated on their role within the screening process. The nurses were educated to provide a mood and energy questionnaire at the time of the blood draw. Providers were educated to discuss the wellness labs and vitamin D screening at each office visit and document this screening within their note.

Implementation was launched on December 19th 2023 after the receipt of IRB approval. Providers began educating the patients on the new protocol during their visits, nurses completed the blood draw and patient questionnaires, and the providers followed up with the patients and created a treatment plan based on their lab and questionnaire. Subsequently, staff provided feedback and suggested blood draw packets be created that included all the necessary questionnaire forms as well as lab forms. This was developed and the staff's response was positive and stated that the new methods eased workflow.

The final phase is maintenance and evolution. The clinical staff noted this process was beneficial to patients and supported the standardized screening process becoming a long-term practice change. A random sample was taken in month three of the QI project and the staff continued to consistently implement the screening process.

Section 4: Aim and Purpose

This quality improvement (QI) project aims to standardize vitamin D screening and therefore, improve patient health outcomes. This quality improvement project aimed to increase individual physical and psychological well-being through obtaining a regular wellness lab draw including components such as vitamin D level.

Section 5: Methods

Section 5.1 Context

The implementation site is a rural clinic in Sheridan, Wyoming that provides annual exams, primary care, and aesthetic services to individuals within the community. Ninety percent of the patient population are women ages 20 to 70 years old. The clinic accepts cash-paying

clients as well as private insurance holders. The clinic does not accept Medicare or Medicaid; however these clients can be served on a cash-pay basis. On average, the clinic has 1000 encounters per month with approximately 350 of those encounters being office visits or annual exams and the others being nursing visits. The rural clinic in Wyoming specializes in women's health and obesity medicine; therefore, a significant portion of the patient population attends appointments at the clinic weekly for weight management counseling and surveillance. The clinic participates in minimal marketing and the majority of the patient population is attracted to the clinic through direct referral or rating from colleagues or acquaintances.

Section 5.2: Intervention

Each patient who attended a visit with a nurse practitioner received screening for vitamin D deficiency. This screening included the provider inquiring about current vitamin D supplementation, and a previous vitamin D lab draw within the past year. This initial screening was conducted by the provider and documented within the patient's chart. The patients who have not had their vitamin D drawn within the past year, the provider recommended a wellness panel be drawn. With the patient's consent, the wellness draw was conducted which included a package of tests: complete metabolic panel, complete blood count, thyroid stimulating hormone, lipid panel, and vitamin D level. At the time of the blood draw, the patients are provided with two questionnaires to screen for mood and energy levels.

Lab results were given to the ordering provider on the same day they were processed. Providers reviewed these labs and contact the patient with their recommended treatment plan. Patients who had vitamin D levels less than 30ng/dL, or those who are below 50ng/dL and symptomatic are offered a one-time 300,000 IU injection of vitamin D or a 10,000 IU capsule,

which they were directed to take Monday through Friday for eight weeks. Patients were educated that the vitamin D injection showed more clinical benefit, but the choice of oral or injectable replacement was left to the discretion of the patient.

Upon implementation of the protocol, the provider made an eight week follow up appointment to redraw the patient's labs. At this lab draw, the patient again filled out the three same questionnaires that was conducted at their initial lab draw: PHQ-9 for depression, GAD-7 for anxiety, and Fatigue Severity Scale (FSS). This data was collected and placed into a flow sheet for evaluation. After the provider evaluated the eight-week serum vitamin D level, the patient was either placed on a maintenance protocol or if the vitamin D levels remained insufficient the previous protocol was repeated. The maintenance protocol consisted of either 2,000 units orally daily or 50,000 units of vitamin D injected once monthly. The patient was advised to have their vitamin D draw in six months to ensure they are within optimal range.

In the scenario where vitamin D levels were not increased after the protocol, further investigation was conducted. According to the Cleveland Clinic (2022), cystic fibrosis, Crohn's disease, celiac disease, obesity, kidney, and liver disease may impact the absorption of exogenous vitamin D and cause persistent deficiency. Patients who do not experience an increase in their vitamin D level after completion of the protocol were scheduled a follow up office visit to conduct further assessment.

In the event where a patient had an elevated screening score within the PHQ-9, GAD-7 and FSS, further investigation and intervention was conducted. The interventions were based upon Table 1: PHQ-9 Treatment Actions per Kroenke et al., (2001). For a result of 5 to 9 or a mild depression screen, patients were asked to repeat the PHQ-9 at the 8-week lab draw.

Individuals who had a result greater than 10 were scheduled a visit with a health care provider at the rural clinic within seven to ten days to be further evaluated and consider medication initiation. For the GAD-7 screening tool, treatment was conducted as follows: A result of zero to four did not receive treatment as it is not required (PAR Staff, 2020). A score of 5 to 7 resulted in follow-up screening, which took place at the eight-week lab draw with a repeat of the GAD-7. A score of 9 to 21 warranted a visit with a nurse practitioner within 7 to 10 days after the initial screening was conducted.

Section 5.3: Measures

Patients Screened for Vitamin D: This quality improvement project was created to achieve the goal of standardizing vitamin D screening. An initial goal was set to screen 100 percent of patients who attended the clinic for an office visit with a nurse practitioner. The screened and unscreened encounters were organized into a flowchart. All of the encounters that fit these criteria were entered into a flowsheet. Providers documented their screening of vitamin D deficiency in their note. The project lead completed a chart review. Within this review, 100 percent of charts were reviewed during the first eight weeks of project implementation. Thereafter, a random collection of 20 percent of the encounters were reviewed. A percentage of individuals who were screened at their encounter was obtained and analyzed for achievement or failure to reach the goal.

Offered Vitamin D Replacement: Patients who received screening and required a lab draw had their blood drawn per the provider's request. The resulting labs, including the serum vitamin D level, was given to the provider. Based upon the results, the provider called the patient to offer them vitamin D replacement or to confirm that replacement was not indicated at this

time. This process was documented within the chart as well as on the patient's lab work. Goal completion was measured by auditing the documentation as well as the written notes on the labs. The completion or uncompletion of this task was tracked within the excel sheet that correlated with the appropriate encounter.

Optimal Vitamin D Levels: Vitamin D levels were drawn per the provider's discretion if the patient did not receive a wellness lab draw, including a vitamin D level, within the past year. Patient's vitamin D levels were replaced as advised by the nurse practitioner and a goal was for the patient to achieve optimal vitamin D levels defined as levels between 70-100 ng/dL. This goal was measured by collecting and evaluating the 8-week lab draw results. These results were tracked in an excel sheet, which affiliated with the encounter.

Section 5.4: Analysis

Following the implementation of the quality improvement project, a thorough audit of patient charts was conducted eight weeks later to assess compliance and effectiveness. Specifically, charts of patients who had scheduled office visits between December 19, 2023, and February 19, 2024, were evaluated. The focus of the audit was on vitamin D screening, which should have been duly documented by the healthcare provider in the note. For charts that indicated screening, the audit extended to include a vitamin D lab draw and examination of the completion of the PHQ-9, GAD-7, and FSS. Additional values collected were the patient's age, body mass index (BMI), their vitamin D level, and the presence of a follow-up visit if indicated. A follow-up visit was required if the patient had an elevated PHQ-9 or GAD-7. The goal was to ensure that all patients receive screening during their office visit, that vitamin D supplementation

is offered to those who need it, and that all patients who are supplemented for eight weeks see an increase in their vitamin D levels to the optimal range of 70-100ng/dL.

To evaluate the data, a correlation analysis was conducted between PHQ-9, GAD-7, Fatigue Severity Scale (FSS) and serum vitamin D levels. This analysis was conducted using Intellectus Statistics. The Pearson Correlation and Spearman Correlation Test were used to compare the variables. Additionally, Microsoft Excel was used to calculate an equal average with standard deviation of the PHQ-9, GAD-7, FSS, and vitamin D levels to evaluate their measure of central tendency.

Section 6: Results

Before the implementation of the quality improvement project in a rural clinic in Wyoming, less than 20 percent of patients were screened for vitamin D deficiency. After the project was implemented, 107 out of 117 patients opted for a blood test, resulting in a screening rate of 91.4 percent for vitamin D deficiency.

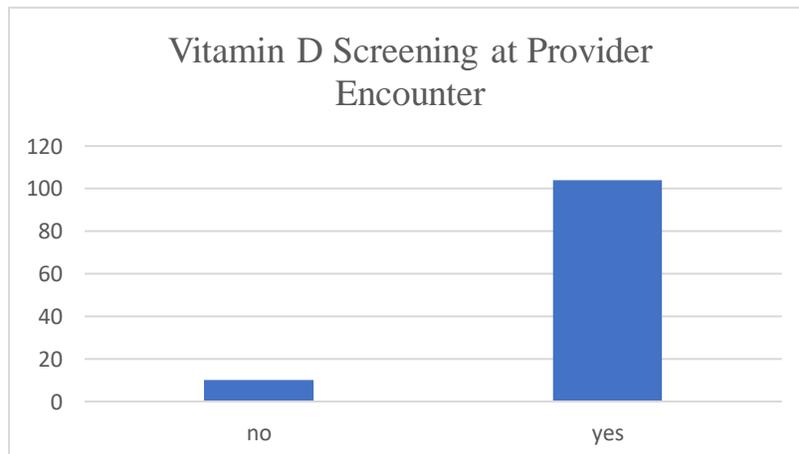
The Pearson and Spearman Tests were used to evaluate the correlation between PHQ-9, GAD-7, FSS and serum vitamin D levels. These analyses concluded that there was no significant correlation between the mood and energy scales with vitamin D levels. The mean with standard deviation was calculated to determine the variables measure of central tendency. The mean of the FSS resulted as 35 with a standard deviation of 13.6. The mean GAD-7 score was 5.3 with a standard deviation of 4.8. The mean of PHQ-9 scores was 7.1 with a standard deviation of 5.1. The mean serum vitamin D level was 36 with a standard deviation of 18.8.

Eight individuals qualified to receive their secondary blood draw within the eligible time to collect data. The mean vitamin D level at the eight-week lab draw, after supplementation, was 52.5.

Section 7: Discussion

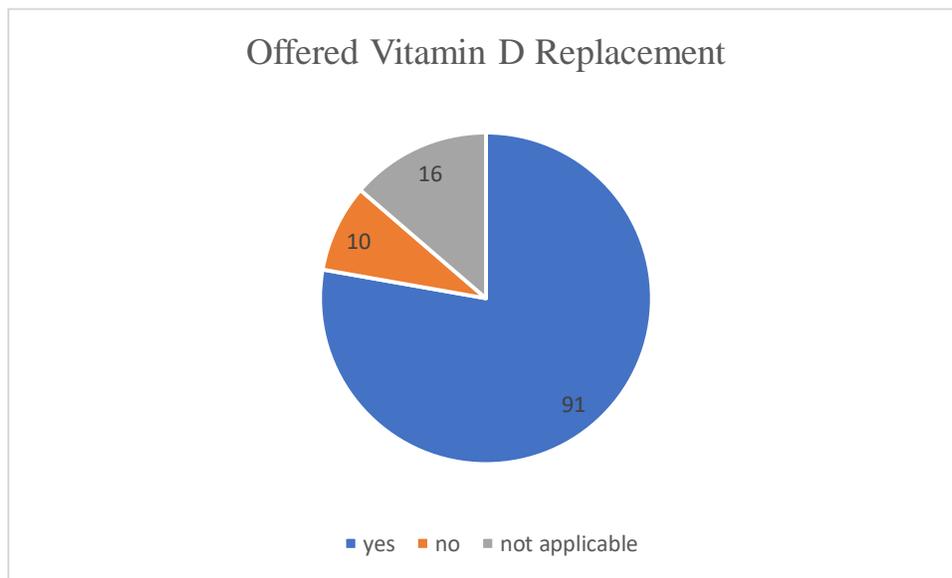
The purpose of this project was to implement a standardized vitamin D screening process that increased frequency of screening, offered patients a vitamin D supplementation as appropriate, and increase patient's vitamin D levels. Over the eight weeks of data collection there were 117 patient encounters that qualified for vitamin D screening. Over 90 percent of these patients received vitamin D screening, which included asking the patient about current or previous vitamin D testing and supplementation. Prior to implementing the standardized screening process, less than 20 percent of patients at the rural Wyoming clinic were screened for vitamin D deficiency. One hundred percent of patients who were vitamin D deficient were offered vitamin D supplementation. Of those who were offered supplementation, one individual refused supplementation due to personal limitations.

Figure 1. Vitamin D Screening at Provider Encounter



Eight percent of the patients seen for an office visit at the rural Wyoming clinic did not receive vitamin D screening. Potential causes of this missed opportunities for vitamin D screening include regular staff being absent, a staff member being on maternity leave, a nurse practitioner working via telemedicine, and training a new staff member.

Figure 2: Vitamin D Supplementation



The patient's mood and level of fatigue was obtained at the baseline lab draw by having the patient fill out a PHQ-9, GAD-7 and Fatigue Severity Scale (FSS). Out of the 117 encounters, 17 percent of patients had a positive screen for anxiety and/or depression. Each of these patients were scheduled a follow up within two weeks of their positive screen to discuss their results and a potential treatment plan to mitigate their anxiety or depression.

A small sample of patients received a second blood draw within the eight-week time frame where data collection took place. Of those patients' 100 percent had an increase in their vitamin D level and 62 percent scored within optimal range, 50 to 80mg/dL.

Section 7.1 Limitations

This quality improvement project includes several important limitations. The patient population was narrow in type of patient encounter and ethnicity. The majority of patients were women obtaining advice on hormone regulation, weight loss, or annual gynecological care. Many patients attended weekly visits, so the opportunity to follow-up and provide education was sufficient. Those who were offered a follow-up office visit due to an elevated PHQ-9 or GAD-7 were seen within seven to ten days, which may not be available in a more populated clinic with less provider availability. Furthermore, the quality improvement project was implemented during the winter, which is a prevalent season to experience vitamin D deficiency due to the northern climate and lack of sun exposure. The rates of vitamin D deficiency could be skewed due to the harsh weather conditions. One of the clinic's primary providers was required to complete visits via telemedicine due to the weather prohibiting her travel. The absence of the provider at the clinic required front desk staff to reschedule in-person procedures. Nursing staff were required to contact patients to come in for their blood draw as opposed to completing it during a scheduled in-person visit.

Section 7.2: Recommendations

Implementing the vitamin D screening process served to be effective in improving patient outcomes. This process could be implemented in other rural clinics who desire a standardized method of screening patients for vitamin D deficiency with careful consideration for the following recommendations.

Patient Population: Over ninety percent of the patients who participated in this quality improvement project were women. Staff should consider this factor when implementing a similar

screening process within a contrasting patient population. Patients at this clinic attended visits monthly; therefore, the ability to follow-up and participate in ongoing management was satisfactory.

Integration of Questionnaires: Mood and energy questionnaires were paramount in this quality improvement project. Ensuring patients had a timely follow-up was essential to addressing an elevated PHQ-9, FSS, or GAD-7. The implementation site made these follow-ups a priority by being adequately staffed with nurse practitioners with ample time in their schedule to accommodate these needs. Optimally, these questionnaires would be completed electronically prior to the office visit and reviewed with the provider in real-time to prevent loss to follow up.

Implement a Maintenance Process: An ongoing screening process should be developed to ensure patient's vitamin D needs are fulfilled long term. Those who achieve optimal vitamin D levels should be educated on the frequency for follow-up and testing. A sample of patient encounters should be collected sporadically to ensure staff members continue to implement the screening process. Developing patient reminders would be beneficial for patients and providers by ensuring continuity of care.

Section 8: Conclusion

Vitamin D is essential in maintaining one's health and quality of life. Adequate vitamin D levels have been shown to improve mood, increase bone density, increase energy, and better one's metabolic function. Raising awareness and normalizing the screening for vitamin D deficiency is paramount to improving patient outcomes. This quality improvement project demonstrated the benefit of screening for vitamin D deficiency and offering supplementation.

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CHAPTER FOUR

ADVANCED NURSING ESSENTIALS REFLECTION

Introduction

In 1986, the American Association of Colleges of Nursing (2021) composed ten essentials, which provide an educational framework for nurses furthering their career. These essentials are the foundational elements that guided Montana State University's Doctor of Nursing program. In my final chapter of my manuscript, I will discuss how outline and provide examples of how these essentials guided my learning and have prepared me for practice as a Doctor of Nursing and Family Nurse Practitioner.

Domain 2: Person-Centered Care

As Maya Angelou so eloquently stated, "People will forget what you said. People will forget what you have done, but people will never forget how you made them feel." Angelou's words describe my mission as a healthcare provider: to deliver compassionate, honest, and sincere individual who approaches every situation with integrity. During the past four years, my doctoral classes and clinical experiences have shaped me to provide holistic wellness and patient-centered care. Courses such as Evidenced-Based Practice I and II, and Vulnerabilities to Healthcare in Diverse Communities have provided me with the foundation and knowledge to provide evidence-based and culturally appropriate, patient-centered healthcare. Through applying this knowledge, I listen to understand, treat my patients individually, and work with my team members to ensure each patient has a positive and memorable experience. I have high expectations of myself as a provider and as an individual; therefore, I strive to bring a positive

attitude, active listening skills, and calm presence to all encounters with my patients and coworkers.

I can recall a particular moment where I cultivated my learned skills to provide person-centered care. A patient came into my clinical site to obtain annual care. The patient had not sought healthcare in some time due to a history of poor experiences. I provided the patient with a safe environment to promote a dynamic interactive experience, listened to understand, and lead a difficult and sensitive conversation to promote patient-centered care. The patient was able to be examined and treated to improve their overall health and well-being while remaining safe and comfortable. Within this case, I referenced the ABCDE tool I learned in the course *Vulnerabilities to Healthcare in Diverse Communities* to guide my care when listening with compassion, empathizing, and to creating an environment which promotes patient well-being while completing any necessary testing and procedures.

Domain 6: Interprofessional Partnerships

Through my professional experiences, I have had the opportunity to network with many members of the healthcare community, nutritionists, physical therapists, behavioral therapists, pharmacists, nurses, medical assistants, and others. In healthcare we often use the phrase, “it takes a village.” This statement rings true to the teamwork necessary to deliver high quality care. Throughout the course of my doctoral program, I have learned that delegation is required to fulfill my role as a provider allowing other colleagues as members of the team to accomplish the tasks that they are qualified for. In other words, delegating tasks such as obtaining vitals, blood draws, or collecting a specimen to a qualified team member creates time for me as a future

provider to complete a face-to-face interaction with my patients while also reviewing lab results and developing the patient's treatment plan.

Delegation and patient allocation are often used synonymously; however, these terms are very different. Delegation involves the transferring of an individual's own work to someone else. Whereas patient allocation is an assignment without a contract of obligation. Patient allocation does not involve the transferring of one's work. According to Ho (2019), allocation commonly occurs in leadership roles, such as the role of nurse manager or a nurse practitioner practicing at a private clinic.

Accountability is critical among healthcare professionals. Having an expectation of accountability promotes better quality patient care. One way to improve better accountability practices is to encourage bi-directional communication. More specifically, after a task has been delegated and completed, reporting to the team or individual who assigned the task would allow all those involved to be informed and up to date on individual patient care. I was able to be a key stakeholder in delegation and bi-directional communication recently in my clinical labs as part of my education. A complex patient came into the clinic who required a multidisciplinary team including communication with healthcare members outside of the clinic to coordinate care. In the moment, I knew I was qualified to complete the necessary tasks, but I would be most helpful "behind the scenes," completing research and phone calls as well as interpreting the lab results obtained from the patient. I delegated the clinical tasks to qualified personnel. In return, the clinicians reported back the abnormal findings within their assessments as well as the lab results for me to review. Having bi-directional communication ensures task completion and timeliness, which fosters effective teamwork and safer patient care.

I have had the opportunity to learn and practice delegation throughout my doctoral program. The course Advanced Nursing Leadership and Roles provided me with the knowledge of appropriate delegation as it is a learned skill that takes practice and time to master. This course prepared me for direct and indirect advanced nursing roles and is emphasized collaboration and, team functioning, and conflict resolution. Knowing the limitations and roles that come with delegation are essential to promoting effectiveness: providers oversee the outcomes of actions they delegate to their subordinates. To sum it up, effective delegation cannot only help with coordination of care, but it can also promote teamwork and therefore better patient outcomes and high-quality patient care.

Domain 8: Informatics and Healthcare Technologies

Health information can be very useful in educating patients on their diagnosis, symptoms, treatment plan and management. On the other hand, not all health information is reliable. There is an abundance of information available through the Internet, so it is essential to understand how to decipher reliable and valid information from that which is un-reliable. Throughout my studies in the MRJCON FNP/DNP program I have had the opportunity to learn more about deciphering data and thereafter practice these learned skills. The healthcare informatics course within our doctoral program provided me with the tools to properly and effectively evaluate research articles. Clinically, I use evidenced-based practice guidelines to guide my care. In addition, I have used these skills to direct my doctoral project as I searched for the most current and evidence-based practice in screening for vitamin D deficiency. These skills have also proven to be beneficial when providing patient education on deciphering what the patient may have read on the internet. Many patients come into the clinic having already given themselves a preliminary

diagnosis derived from their internet search. I make countless efforts to educate patients on deciphering the information they have as I strive to provide them with informed decision making.

When searching the Internet, patients should consider who is publishing the information, who the authors are, their credentials, if they are biased, and if the article has been peer reviewed. Peer reviewed articles have been read, evaluated, and approved for publication by experts in the applicable field. Furthermore, it is important to consider whether the article is accurate based upon the currency of the document, supporting facts, and scientific evidence I ensure patient understand that documents or articles that are not supported by facts are unreliable. Furthermore, it is important to assess the author's purpose. If the document is written by the manufacturer of a product, there is likely to be bias due to their intent of selling the reader a product.

Learning how to competently and effectively decipher healthcare information has propelled my patient care. I strive to provide evidence-based healthcare to my patients and explain the "why" behind my actions. Terminating patient's use of the internet to provide a rationale to their symptoms is not feasible. Instead, I have made it my mission to share my education and provide patients with their own set of tools, so they are also making evidenced-based decisions when seeking medical care.

Domain 10: Personal, Professional, and Leadership Development

There are both leaders and managers in the healthcare world; however, each manager needs to encompass qualities of a leader to be effective. As President Dwight D. Eisenhower stated, "Leadership is the art of getting someone else to do something you want done because

he wants to do it. In other words, leaders have people follow them while managers have people who work for them. Leaders are essential to any organization. Leaders are able to, “influence, motivate, and enable others to contribute toward organizational success” (Nayar, 2014). The Montana State University College of Nursing faculty have been crucial in my leadership development. The faculty display leadership through encouraging collaboration with peers, and providing opportunities for critical discussions. The faculty facilitate learning by providing constructive criticism of assigned projects and our manuscript.

I have had the opportunity to participate in a variety of clinical settings throughout the practicum portion of my training. I have found that every clinic or setting has a “management role.” A positional name does not define the criteria of the role. In order for an individual to qualify for these “management roles” they need to possess qualities of a leader: respect, positivity, responsibility, kindness. Most commonly, the nurse practitioner or medical doctor is a leader within the clinical realm of the clinic. I have witnessed a variety of individuals fill this role, but one in particular stands out. This exemplary healthcare provider strives to cultivate a relationship with her coworkers through arranging teambuilding activities outside of work. She displays professional maturity by reflecting on her own actions and providing open communication for improvement. She is committed to mentoring others to aid in professional accountability and growth. We have daily reflections regarding my care, health care decision making, and charting where she provides constructive feedback to improve my skills as a future provider. I appreciate her humbleness as she often refers to herself as a member of the leadership team.

Conclusion

The Doctor of Nursing Practice (DNP) program and Montana State University has not only prepared me for practice, but it has also prioritized and conveyed the ten domains displayed by the American Association of Colleges of Nursing (2021). These domains have been deliberately integrated into the Montana State University curriculum to broaden and deepen student's understanding of the essential elements of nursing practice. These domains will remain paramount and guide me in the upcoming years of practicing as a family nurse practitioner.

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APPENDICES

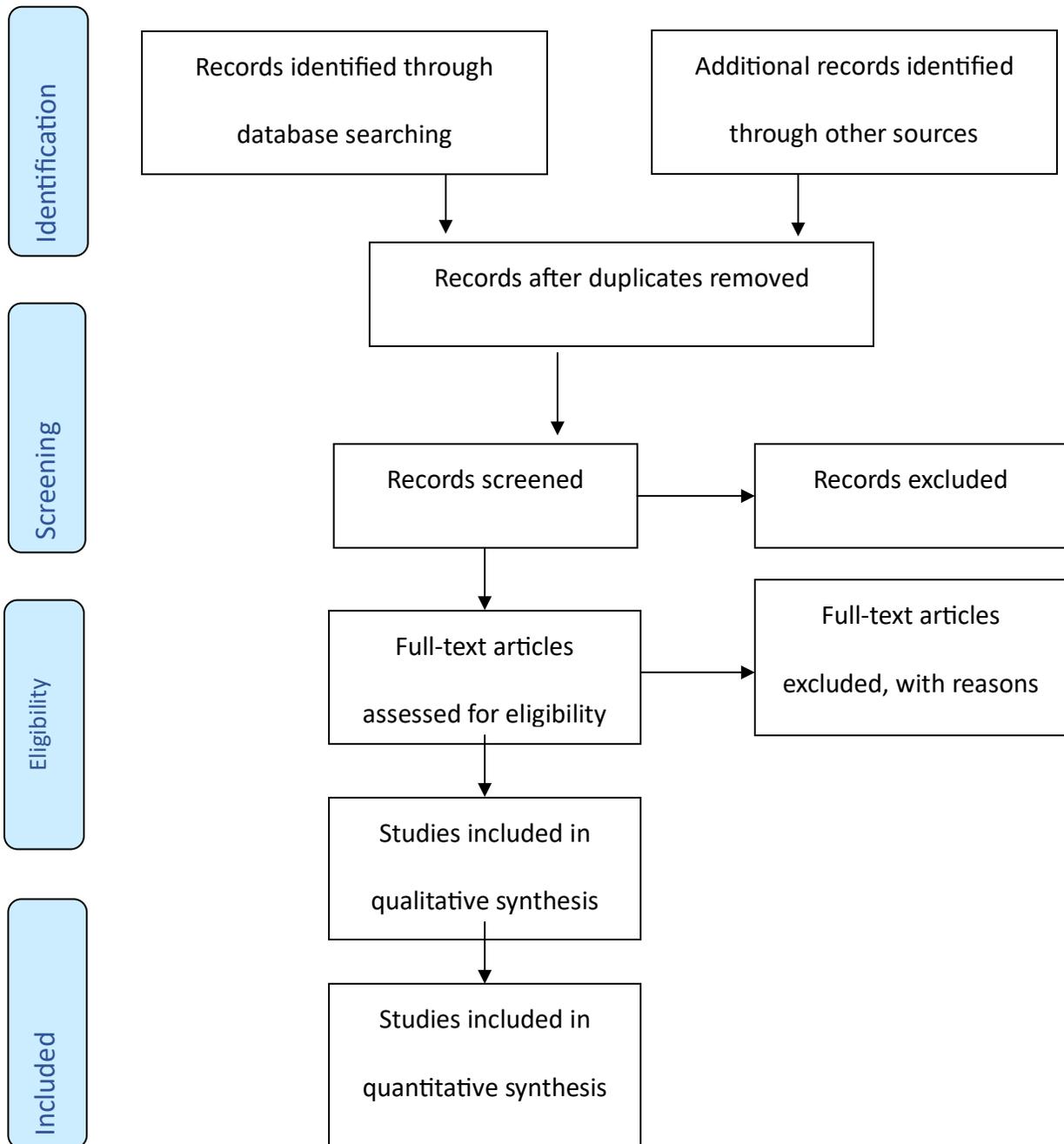
APPENDIX A

PRISMA DIAGRAM

Appendix A: PRISMA Flow Diagram indicating research to develop the review of literature.



PRISMA 2009 Flow Diagram



APPENDIX B

SMART GOALS

Appendix B: SMART Goals

<p>SMART Goal #1: 100% of patients who have an office visit with a nurse practitioner are screened for a vitamin D deficiency Description of Strategies: Providers have been educated of screening process and understand the responsibility of asking patients about their recent blood draw, previous screening for vitamin D, and vitamin D supplementation.</p>		
<p>Data to be collected:</p> <ul style="list-style-type: none"> • Number of office visits and annual exams from December to March • Number of patients screened for vitamin D deficiency at office visit 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Nurse practitioners are responsible for screening • QI project lead will run a report for presence of screening through EMR 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Office visits and presence of screening will be presented in a flowsheet in Excel
<p>SMART Goal #2: 100% of patients who are vitamin D deficient are offered the vitamin D replacement protocol Description of Strategies: The nurse practitioners are responsible for offering the protocol based upon the patient’s lab result. The nurse practitioner will deem the patient vitamin D deficient or sufficient and offer the protocol as they see fit. All patients who are deficient will be offered the protocol and their acceptance or denial of supplementation will be documented by the provider.</p>		
<p>Data to be collected:</p> <ul style="list-style-type: none"> • Number of patients vitamin D deficient • Number of patients who are contacted and offered vitamin D protocol • Number of patients who begin the protocol 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Nurse practitioners are responsible of offering the protocol to patients • QI project lead will run a report on patients who were offered protocol, number accepted, number refused 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Chosen protocol will be tracked in a spreadsheet (PO vs IM) for reference • All questionnaire forms will be placed in patient’s chart for reference and vitamin D scores will be tracked throughout project at baseline and 8 weeks. • Track patient education and offering or protocol in EMR via patient note in “education” section

SMART Goal #3: 100% of patients who received vitamin D replacement will have optimal vitamin D levels (70-100ng/dL) at their 8-week lab draw

Description of Strategies: a vitamin D lab draw will be conducted at baseline per the provider's order. The nurses will be responsible for drawing this lab. Thereafter, if patients accept the supplementation protocol, their labs will be redrawn at eight weeks by the nurses. These results will be analyzed and compared by the QI project initiator and nurse practitioners.

<p>Data to be collected:</p> <ul style="list-style-type: none"> • Vitamin D levels at baseline and 8 weeks 	<p>Method of Collection and who is responsible:</p> <ul style="list-style-type: none"> • Collection for Clinic lab site as well as EMR by QI project lead 	<p>Planned data analysis:</p> <ul style="list-style-type: none"> • Data will be input into excel sheet and SPSS will be used to analyze
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