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Continuous Glucose Monitoring and Diabetes Management During Pregnancy

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NURS-795 DNP Project

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November 7, 2020
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Abstract

According to the Scope of Practice, Standards of Practice, and the Standards of Professional Performance for Diabetes Educators, registered nurses play an integral role in the promotion of diabetes self-management education and training in diabetes care (AADE, 2017). This paper upholds the standards set forth by the American Association of Diabetes Educators (2017) governing body, to stimulate the process of peer review, promote documentation of the outcomes of diabetes self-management education and training (DSME/T), encourage research to validate practice and improve quality DSME/T and diabetes care for pregnant women who use continuous glucose monitoring. To improve registered nurse education and diabetes practice, the Continuous Glucose Monitoring and Diabetes Management During Pregnancy Program was presented to the management and leadership of a high-risk subspecialty unit of a major Northern California healthcare maintenance organization. The implementation unit provided the staff, resources, and interest needed to support the project. The information provided in this paper discuss the needs assessment that was conducted as a basis for implementation of the pilot project. The SWOT analysis and Work Breakdown Structure (WBS) are project management tools that were utilized as part of the proposed Continuous Glucose Monitoring and Diabetes Management During Pregnancy Program Doctor of Nursing project. The SWOT analysis provides details about barriers to the project, support for the need, and objectives enacted to overcome obstacles, and elicited sponsor, provider, and team member support. The WBS was used as a communication tool to inform, update, and review progress to ensure the project was completed on time and within budget. The budget forecasted the need of approximately
$3,000.00 to successfully implement the project. The outcome measurement tool used to
determine the success of the project was qualitative data received from the registered nurses
upon completion of the CGM device training modules. Qualitative data was gathered from the
registered nurses using Qualtrics pre- and post-education and training. The secondary outcome
measurement tools were the latest lab result HgbA1c of <7.0 mg/dl and a reduction of
hypoglycemic episodes during pregnancy.
Introduction

Diabetes and Pregnancy

Safely achieving near-normal blood glucose levels remain the primary goal of clinicians who provide care for pregnant women with preexisting and gestational diabetes. However, the number of women affected by preexisting diabetes has increased over the years, making achieving near-normal blood glucose challenging due to many factors, including maternal obesity. Since 2010 the United States has experienced an increase in prevalence of obesity by 17.8%; likewise, the upward trend of diabetes has seen a similar increase (Bhupathiaju & Hu, 2016). According to researchers (Bhupathiaju & Hu, 2016; Hunt & Schuller, 2007), obesity is a major risk factor for type 2 diabetes, is considered a public health problem, and affects women more than men. Researchers (Hunt & Schuller, 2007) suggests the incidence of diabetes continues to rise, increasing the risk of diabetes during pregnancy of women in their child-bearing years. The prevalence of gestational diabetes in a population reflects the prevalence of type 2 diabetes in that population (Hunt & Schuller, 2007), due in part to women with gestational diabetes being at a greater risk of converting to type 2 diabetes within five to 10 years of giving birth (Kim, et al., 2002). Further, as the overall rate of obesity and diabetes have risen over the years, so has the number of pregnant women with preexisting diabetes. From 2012-2016, the U.S. prevalence of preexisting diabetes during pregnancy rose from 0.7% to 0.9% (CDC, 2018). In 2009, roughly 1%-2% of pregnant women diagnosed with either preexisting diabetes or complicated gestational diabetes required antihyperglycemics to control blood glucose (CDC, 2013, Law, et al., 2015, Sung, et al., 2012). These statistics are important to note because the increased prevalence represents an increase in insulin resistance during pregnancy for these
women, requiring increasing doses of antihyperglycemics to control diabetes during pregnancy, while at the same time increasing their chances of episodic hypoglycemia.

During the Consensus Conference of the American Association of Clinical Endocrinologists and American College of Endocrinology, leading experts in the field determined CGM is likely to provide benefits for women with diabetes who are planning pregnancy, as well as women with gestational diabetes (Fonseca, et. al., 2016). Further, consensus participants unanimously agreed that patients who are prescribed antihyperglycemics may also benefit, but barriers to the technology exist. CGM technology allows clinicians to recognize fluctuations in blood glucose values, but this requires education and training.

For women with preexisting diabetes, blood glucose management in pregnancy begins at the first prenatal visit. For some women, gestational diabetes is diagnosed later in the pregnancy due to hormonal changes that occur within the placenta (Ngala, et al. 2017). Lifestyle management, medical nutrition therapy, physical activity, stress, and sleep hygiene should be part of the healthcare maintenance discussion for the pregnant woman with diabetes (ADA, 2020). Diabetes education begins with setting clear goals for maintaining optimal blood glucose levels during pregnancy, clearly stating the maternal and fetal risks of hypo- and hyperglycemia, discussing lifetime risks associated with diabetes during pregnancy, expected pregnancy management and outcomes, and plans for delivery.

The recommendation for women with insulin dependent preexisting diabetes in pregnancy is to check blood glucose at least seven times per day; for women with gestational diabetes the recommendation is to check at least four times per day, while both populations should be periodically counseled to achieve regular daily physical activity for 30-60 minutes, and
to consume the nutritional accepted daily recommended intake (DRI) for pregnancy (ADA, 2020). Table 2 illustrates the ADA recommended guidelines during pregnancy.

**Diabetes During Pregnancy Practice Guidelines**

The American Diabetes Association publishes the Annual Practice Guideline for clinicians to use to enhance care for pregnant women with diabetes. Table 2 demonstrates the HbA1c and blood glucose targets recommended for pregnancy (ADA, 2020). The ADA recommends fasting and postprandial glucose monitoring during pregnancy, and that some women with preexisting diabetes or complicated gestational diabetes also test preprandial blood glucose, although there is no set target goal found. For women prescribed antihyperglycemics with multiple daily injections (MDI) or insulin pump infusion, the ADA recommends preprandial glucose monitoring and one-hour postprandial glucose monitoring for premeal rapid-acting insulin adjustment. CGM use among women with chronic diabetes during pregnancy, in addition to standard care, demonstrate a mild improvement of HbA1c without an increase in hypoglycemia. The Medtronic Guardian and the Dexcom G6 are the two CGM devices that have received FDA approval for use during pregnancy. The Medtronic Guardian CGM uses the CareLink software for data upload, download, and interpretation. See Figure 1 for the Dexcom Clarity CGM software and Figure 2 for the Medtronic CareLink CGM software used for this review. See Table 3 for the continuous glucose monitoring device comparison.

The American Diabetes Association (2020) recommends continuous glucose monitoring devices in conjunction with insulin therapy for adults with type 1 and type 2 diabetes. CGM therapy is effective in lowering A1c levels, reducing hypo- and hyperglycemia, and is deemed
safe for those with hypoglycemia unawareness. Further, CGM use improves A1c levels, time in range, and neonatal outcomes in pregnant women (ADA, 2020).

**Problem Description**

The implementation site was a subspecialty high risk obstetrical unit within a major Northern California healthcare maintenance organization. The unit provides care to high risk obstetrical patients referred by obstetrical providers and perinatologists throughout the region. The unit operates at an average daily census of nearly 2000 patients assigned to a core of eight registered nurse on dayshift and on evening shift to manage pregnancy complications such as preterm birth, hypertension, and diabetes. The number of women referred to the unit for management of diabetes during pregnancy has increased over time. In fact, the rate of women pregnant with pregestational diabetes during pregnancy increased 37%, while women diagnosed with gestational diabetes increased 56% from 2000-2010 (CDC, 2013). The registered nurses are assigned a daily list of patients to call for telehealth appointments. These appointments typically take 15 minutes to gather blood glucose data, review antihyperglycemic regimen, synthesize information and data, and develop a treatment plan.

The unit operates 16 hours per day, seven days a week, and is open during all holidays. Each of the eight registered nurses typically have 20-25 patients to call during the shift. Patients referred to the unit were assigned a weekly telephone appointment. If a patient did answer the call during the appointment time, the registered nurse left a message, and rescheduled the patient within the shift when the patient called back. Women pregnant with chronic diabetes were referred when viability was confirmed by observed cardiac activity and when the fetal pole measured 7 mm on a transvaginal ultrasound corresponding with a gestational age of 6.0-6.5
weeks (Gupta & Roman, 2019). From the first trimester, women spent an average of 28-36 weeks enrolled in the program. Women diagnosed with gestational diabetes were enrolled between 24-28 weeks gestation and spent between 12-16 weeks on the program.

The blood glucose status of women referred to the unit range from controlled, somewhat controlled, to uncontrolled. Most were currently using insulin, Glyburide, or minimal Metformin dosages to control their blood glucose at the time of the referral to the unit. Once enrolled in the program, the registered nurse educated the patient on diet, exercise, and lifestyle changes to better control their blood glucose. After one to two weeks on service, the registered nurse made a recommendation to the provider to optimize blood glucose control. The provider determined the treatment plan, scheduled a one-on-one teaching appointment with a clinical registered nurse, then sent a new medication order to the unit. The registered nurse subsequently and periodically titrated the antihyperglycemic medication based on a protocol that was approved by the leadership of the implementation unit.

Some women with chronic diabetes or complicated gestational diabetes were referred to the unit with continuous glucose monitoring devices already in use. Prior to the pilot, the registered nurse sent blood glucose reports to the primary care obstetrical provider or to the perinatologist to make insulin adjustments rather than interpreting the data and adjusting the insulin dosage at the point of care. This practice delayed patient care, limited registered nurses from working at the top of their licenses and did not uphold the scope of practice outlined by the American Association of Diabetes Educators (2017). The AADE scope of standards guide diabetes educators’ practice, which include registered nurses as members of the diabetes care team. Fonseca, et. al., (2016) recommends continuous glucose monitoring (CGM) training be
made widely available to clinicians such as nurses and nurse practitioners, without formal certification, as this adds barriers to CGM usage and isn’t necessary. Fonseca, et. al., (2016) also suggests clinician training be expanded to all clinicians who care for patients with diabetes. This pilot demonstrated CGM capabilities in a telehealth nursing unit, expedited patient care, and allowed the primary care provider to commit time to acute patients who needed to be seen in clinic. Prior to the pilot, no established standardization for utilizing CGM during pregnancy existed for nursing staff. CGM and diabetes management education ensured registered nurses in a telephonic nursing unit were prepared and competent making insulin dosage titration based on the CGM Time in Range report. Per discussion with the leadership of the implementation unit, a nurse practitioner-developed protocol for insulin adjustment was used for this project. See Appendix K and Table 1 for the insulin titration protocol.

**Available Knowledge**

**PICOT**

Would nurses providing care to pregnant insulin-dependent women using CGM device technology, compared to pregnant insulin-dependent women receiving standard care, demonstrate increased confidence and competence when patients have a 50% decrease of hypoglycemic episodes within three weeks of starting the program? To answer the question about the reliability and accuracy of the continuous glucose monitoring time in range report used by registered nurses as a clinical decision-making aid, compared to the standard care provided to pregnant women with diabetes, a broad search of CINAHL Complete, Joanna Briggs Institute of EBP (first search and PubMed), and Scopus electronic databases using the search terms “diabetes, pregnancy, continuous glucose monitoring, nurse, training, education, and nurse
practitioner” yielded 113 articles. Subsequently, 59 filtered free full-text, abstract, clinical trial, random controlled trial, and systematic reviews published between 2010 to 2020 were accepted. After further review, the remaining 16 articles used were limited to the English language; articles that did not contain continuous glucose monitoring and pregnancy in the title, and articles without an abstract were removed. Exclusion criteria of CGM devices other than Dexcom G6 or Medtronic Guardian were applied because other devices used in the United Kingdom are not approved for use in the United States by the Federal Drug Administration. The common themes found in the reviewed articles were CGM therapeutic decision-making, CGM time in range report provides clear goals, CGM use lowers HbA1c levels, CGM use reduces diabetes-related complications, CGM education and training for nurses, and the role of the nurse practitioner. Appendix A details the review of evidence grid.

**CGM Guides Therapeutic Decision-Making**

CGM is a safe and effective method to guide therapeutic decision-making for pregnant women with diabetes when placed on the upper arm. Reliable CGM results correlate with the self-monitoring blood glucose (SMBG) results, often detecting postprandial hyperglycemia, and nocturnal hypoglycemia better than SMBG testing alone. The Time In Range (TIR) report has been validated by multiple CGM clinical trials as a valuable tool for clinical decision-making about insulin adjustments and has been proven to predict blood glucose trends so that changes can be made in a timely manner (Castorino, Polsky, O'Malley, Levister, Nelson, Farfan, Brackett, Puhr, & Levy, 2020; Gabbay, et al, 2020; Mazze, Yogev, & Langer 2012; Polsky & Garcetti, 2017). The accepted glycemic variability range is 70 mg/dl to 180 mg/dl (ADA, 2020). CGM accuracy and pattern reliability is not different than that of non-pregnant participants with
diabetes. The Polsky & Garcetti (2017) study reported more values in the target range and provided more blood sugar values than women not using a CGM. The accuracy of the Dexcom G6 CGM to that of fingerstick blood glucose results (Castorino, et al., 2020) demonstrated CGM accuracy of 92.5% when compared to that of non-pregnant Dexcom G6 CGM users who placed the CGM on the upper arm. The study found the results of the Dexcom G6 CGM to be less accurate when placed on the abdomen, or buttocks of pregnant women with diabetes. These studies demonstrate that women with diabetes benefit from CGM device placement on the upper arm, which results in more accurate data for providers to base clinical decisions.

**CGM Time in Range Report Provides Clear Goals**

Time in range (TIR) is the optimal blood glucose level achieved without inducing signs and symptoms of hypoglycemia and has been correlated with less complications of diabetes. However, if patients are to be counseled to maintain blood glucose in the optimal range, registered nurses need to be trained to assess CGM data to make insulin adjustments. Eight articles offered similar definitions and rationales for selecting TIR as a valuable tool for clinical decision-making (Battelino, et al., 2019; Brown et al., 2019; Feig, et al., 2017; Gabbay et al., 2020; Mazze, et al., 2012; Polsky & Garcetti, 2017; Vigersky & McMahon, 2019; Zaharieva, et al., 2020). The International Consensus in TIR advocates for the use of TIR reporting as a standardization for report glucose control and highlight the need to train clinicians and patients on how to access, interpret, and use CGM tools to answer questions about glycemic control and outcomes (Gabbay et al., 2020). According to researchers, participants who showed a high TIR percentage indicated optimal glucose control and longer periods in the target range (Gabbay et al., 2020). Similarly, reviewed studies support the conclusion that CGM provides complex data
requiring analysis by trained clinicians. The TIR report is the most widely accepted CGM download, most accurately measures blood glucose, and is relatively easy to interpret by trained clinicians. As a blood glucose monitoring resource, the TIR is a valuable tool used to identify nocturnal hypoglycemia when the patient displays nocturnal hypoglycemia unawareness (Brown et al., 2019).

**CGM Use Lowers HbA1c Levels**

CGM use is associated with lowered HbA1c levels within 3 months of intensive diabetes management or at the end of the pregnancy. The findings of the Advanced Technologies & Treatment for Diabetes Congress were commissioned to develop clinical CGM targets to be used by clinicians and others in interpreting reported CGM data (Battelino, et al., 2019). This study reported 31% of CGM users with lower HbA1c levels after 4-6 weeks of monitoring, and significantly lower HbA1c at 36 weeks gestation (Battelino, et al., 2019). The commission recommended 3 core metrics specifically targeting CGM use during pregnancy. The 3 metrics were identified as 1) percentage of blood glucose readings and time per day in the target range, 2) time below the target range, and 3) time above the target range. The commissioned experts mutually agreed upon target percentages of TIR as the benchmark for making insulin adjustments for diabetes in pregnant patients. Evidence supporting the use of the TIR report show there is a strong relationship between percentage TIR and HbA1c when CGM results are compared to SMBG results (Vigersky & McMahon, 2019). In relation to the HbA1c levels of 1,137 participants with type 1 or type 2 diabetes, researchers successfully demonstrated TIR without episodes of hypoglycemia was achieved by use of CGM during pregnancy and was verified by HbA1c test- the gold standard of glycemic control. The Vigersky and McMahon
(2019) review discovered that for every 10% change in TIR, study participants achieved an average 0.08% change in HbA1c. Likewise, Feig, et al. (2017) reviewed the risk of low percentage TIR in the Diabetes Control and Complications Trial (DCCT) data. The DCCT is an on-going, multicenter random controlled trial studying woman aged 18-44 who are <13 weeks 6 days pregnant with type 1 diabetes. This on-going clinical study spans across England, Canada, Scotland, Spain, Italy, Ireland, and the U.S., and is designed to determine if intensive blood glucose concentrations kept as close to normal result in early vascular complications.

**CGM Use Reduces Risk of Diabetes-Related Complications**

The difference in TIR between those that develop eye or kidney disease and others is related to a decrease in TIR of approximately 2.5 hours per day in the acceptable range for those using CGM. In the Feig, et al., (2017) study, pregnant CGM users spent more time in target at 68% than did the SBMG users who spent only 61% in the target range. This study concluded that TIR is strongly associated with risk of microvascular complications and can be used as another endpoint for clinical investigations, but further studies are needed. Another such example is the Beck, et al., (2018) review that reanalyzed the dataset of the DCCT study to search associations between TIR and development or progression of microalbuminuria or retinopathy. Using 545 subjects with type 1 diabetes out of 1,440 DCCT participants, researchers looked at capillary measurements for one day every three months resulting in 32,528 quarterly data collections with seven patient profiles complete for 24, 892 datasets, and found 19% met the criteria for microvascular complications, while 9% met the criteria for microalbuminuria. Of the 1,440 participants, CGM users improved TIR by 80% and reduced hypoglycemic events by up to 40%. The results of this study predict an increase in percent TIR decreases cumulative incidents of
myocardial infarction, end-stage renal disease, severe vision loss, and amputations, lowering overall healthcare costs by $6.7-$9.7 billion over 10 years.

**CGM Reduces Incidence of Hypoglycemia**

CGM users spend less time and have fewer incidents of hypoglycemia than SBMG users. CGM use among women with diabetes during pregnancy reduces incidents of hypoglycemia, and reduces the time spent with hypoglycemia symptoms. Hypoglycemia is defined as blood glucose <70 mg/dl, while severe hypoglycemia is defined as <54 mg/dl. Both terms are universally accepted (ADA, 2020). The goal of CGM is to identify episodes of hypoglycemia that otherwise would not be captured by self-blood glucose monitoring of fingersticks at certain points in time. CGM users are alerted 30-90 minutes of an impending hypoglycemic episode and can act before feeling signs and symptoms. Symptoms of hypoglycemia include confusion, sleepiness, tachycardia, diaphoresis, hunger, and irritability. CGM data can be accurately relied upon and can be used as an effective means to record nocturnal glycemia to make individual adjustments.

Women with preexisting diabetes spend less time in hypoglycemia with continuous glucose monitoring. In a study of randomized pregnant and nonpregnant adults, participants showed a 48% reduction of nocturnal hypoglycemia, a 65% reduction of severe nocturnal hypoglycemia, and a 40% and 54% reduction in daytime hypoglycemia and severe hypoglycemia, respectively (Zaharieva, et al., 2020), but longer studies are needed to determine the longer-term effects of CGM device use. For example, Polsky & Garcetti (2017) found that participants who spent more time in the optimal glycemic range experienced less episodes of hypoglycemia. In an alternate study, women with gestational diabetes or preexisting diabetes wore a Medtronic Guardian CGM device to measure glucose exposure, glucose variability, and
percent of time spent in hypoglycemia for at least 3 days on the abdomen area. All subjects were treated with antihyperglycemics such as insulin, glyburide, or metformin during pregnancy. The 3-day CGM results were compared to 31 non-pregnant women with preexisting diabetes during the same time period and resulted in less episodes of hypoglycemia (Mazze, et al., 2012).

**CGM Education and Training for Nurses**

Registered nurses are ideally positioned to provide education to people living with diabetes, however, registered nurses without formal diabetes education lack the knowledge to provide critical education to patients. Under direction and protocol of nurse practitioners, registered nurses who work with patients with diabetes would benefit from CGM training, intensive education and precepting on diabetes technology and management (Hollis, et al., 2014). With CGM training and education, registered nurses can address knowledge gaps using best practice guidelines and health promotion principles (Berget & Wyckoff, 2020). In the 51 U.S. nursing jurisdictions, registered nurse scope of practice is broad and allows for development and knowledge transfer. (Jones, 2015; Temple University, 2015). Nursing scope of practice allows for dependent function, authorizes direct and indirect patient care services, including the administration of medications and therapeutic agents necessary to implement a treatment ordered by and within the scope of licensure of a physician (CA Board of Registered Nursing, 1995). Nurses use skills that build on traditional models of collaborative care, promoting rapid uptake of integrative technology, and support a broader context of the nursing process of assessment, planning, implementation, and evaluation of the whole patient (Jones, 2015). Registered nurses who specialize in diabetes management enhance opportunities for chronic-disease self-management education and support. Nurses trained to titrate insulin dosages for women using
CGM as adjunct therapy to multiple daily injections enhance diabetes control during pregnancy. Utilizing the diabetes educator nurse leads to better outcomes and reductions in the risk for long-term complications (Jones, 2015).

**CGM Certification**

The Association of Diabetes Care and Education Specialists (ADCES) launched a new CGM certificate program for those working in diabetes management to improve clinical outcomes for people who use CGM technology (ADCES, 2019). The certification program is voluntary and not required for practice in diabetes management. Access to the certificate program is free for ADCES and American Association of Diabetes Educators (AADE) members. Enrollees receive a certificate and earn up to 14.50 continuing education credits for completing the online program, which can be applied toward registered nurse license renewal (ADCES, 2019).

**CGM in Practice**

Registered nurses care for patients using CGM in many different practice settings. The US Food and Drug Administration has approved CGM for use in the school settings where over 50% of children with type 1 diabetes under the age of 18 use CGM technology. School nurses rely on guidance from the American Diabetes Association (ADA, 2020) Safe at School education and training tools on continuous glucose monitoring. The ADA offers courses designed to assist school nurses with valuable information to reduce the burden that diabetes has on children in school. The recommendations for use of continuous glucose monitors in the school setting offers a summary of benefits on CGM use in the school setting.
As an example, in other areas of practice, school nurses are part of the healthcare team for students attending school with type 1 diabetes and who use CGM (Berget & Wyckoff, 2020). With the increasing use of CGM among adolescents with type 1 diabetes, school nurses play a vital part in caring for these students and must be comfortable providing care to support CGM use during school hours. In addition to glycemic control management, school nurses must receive education related to CGM devices, calibration requirements, and related reports and trends. In collaboration with the primary care provider, the school nurse provides diabetes care management to ensure optimal growth and development of the adolescent in her care. For example, school nurses receive training to recognize arrow trends on CGM devices to predict a rise or fall of a student’s glucose level, and utilization of the data-sharing capabilities to remotely monitor blood glucose levels, minimizing frequent education interruptions while the student is in class (ADA, 2020).

Nurses are in a unique position to educate interdisciplinary staff, patients and their families by being an extension of the care patients receive in the clinic by the primary care provider. In a separate study that measured nurses knowledge related to diabetes education and training for nurses, Hollis, Glaister, & Lapsley (2014) found registered nurses received average scores on basic diabetes management principles but scored significantly higher than average after received additional CGM and diabetes education and training. In a follow-up questionnaire, registered nurse qualitative data indicated increased confidence and competence in managing people with diabetes (Hollis, et al., 2014).

**Role of the Nurse Practitioner**

Nurse practitioners play a critical role in diabetes care, routine monitoring and
management of patients with diabetes. Nurse practitioners promote self-management, decision support, and delivery system design. Patient education by nurses and nurse practitioners improve the percentage of patients reaching metabolic targets. In a study measuring outcomes of patients receiving diabetes education from a nurse practitioner-run clinic, one single visit with a diabetes specialist nurse improved HgbA1c at 6 months with continued improvement to one year (Kruger, 2012). In a retrospective, cross sectional design study, patients with diabetes received specific interventions according to a predetermined protocol. The clinic nurse performed the treatment management by following the American Diabetes Association guidelines and followed patients for 25 months. The clinical nurse gave personal counseling and educated patients about the disease process and control, diabetes management targets, and follow up clinic visits during telephone appointments. As a result of the nursing interventions, the patients’ blood glucose showed a marked improvement (Ginzberg, et al., 2017).

**Rationale**

The Change Theory of Nursing is the basis of this paper’s theoretical framework. The nursing theory was developed by Kurt Lewin to explain the phenomenon of overcoming resistance to change. The three major concepts of the Change Theory are driving forces, restraining forces, and equilibrium. Driving forces are those that facilitate change, leading to the desired results. The driving force shift a change in the equilibrium. Driving forces and restraining forces push change in the opposite direction, leading to a hinderance of change and an equilibrium that oppose change. Equilibrium can be altered by the changes that occur between the driving and restraining forces (Kaminski, 2011).
The three stages of the nursing theory are unfreezing, change, and refreezing. Unfreezing involves utilizing a method to encourage the release of the old way of getting things done that are not productive. Many patterns in nursing can be improved by fostering an environment that promotes group conformity. This is achieved by increasing the driving forces that oppose the existing situation. Decreasing the restraining forces that contribute to disequilibrium and combing the increasing driving forces with the decreasing restraining forces is the process of this framework (Kaminski, 2011). The premise of Lewin’s Change Theory helps to explain the phenomenon of registered nurses being reluctant to adjust insulin dosages for pregnant women who use continuous glucose management devices as adjunctive therapy even though it is within the scope of their practice, and the policy and procedure exists to help them carry out procedures safely. CGM use in pregnancy effectively identifies low blood sugar so that insulin dosages can be adjusted by registered nurses, thus expediting care, increasing patient safety, adequately controlling blood glucose, eventually restoring the counterregulatory hormone response, and improving patient awareness overtime (Tkacs, 2002). See Figure 3 for Lewin’s Theory of Change.

Specific Aim

This project changed clinical practice by providing a clinical decision-making tool for registered nurses, improved the blood glucose of pregnant women who use CGM during pregnancy, provided the registered nurse with a provider-developed insulin titration protocol that quickly identified blood glucose trends, such as hypo- and hyperglycemia, eliminated the delay in care and improved the care that registered nurses provided to this vulnerable population. As a result of improved clinical decision-making,
the registered nurses felt empowered to take swift action to make insulin adjustments using the new insulin titration protocol, thereby reducing the rate of hypoglycemia for pregnant women who use CGM during pregnancy by 50% in the first 3 weeks of the start of the pilot. See Appendix K for the provider-developed insulin titration protocol.

Lewin’s Theory of Change

Lewin’s Theory of Change was the basis of the three-step process to effectively implement the provider-developed protocol. The first step of unfreezing began with the initial needs assessment conducted to identify the gap in patient care provided to pregnant women who use CGM during pregnancy. The previous practice of forwarding collected blood glucose data to the provider who then made insulin adjustment recommendations delayed care and allowed for continued risks of hypo- or hyperglycemia events. The second step of Lewin’s Theory of Change occurred during the education and training on CGM technology use during pregnancy, Time in Range report interpretation, review of the provider-developed insulin titration protocol, and professional CGM documentation and communication with the primary provider. The final step of Lewin’s Change Theory took place during refreezing at the point when the new CGM during pregnancy pilot was implemented.

Methods

Context

Assessment of the CGM technology interest, current nursing knowledge gap of CGM device technology and report interpretation was necessary to determine the level of education needed to provide evidence-based care to this vulnerable population. To
accomplish this goal, the nursing staff completed a knowledge-based assessment on CGM clinical use and decision-making which was the basis for the nursing CGM education. This initial assessment also determined the level of interest for the pilot project. Prior to the CGM education, the registered nurses took a pretest to measure CGM competency, while the post-test assessed the efficacy of the CGM training.

**Intervention**

The intervention was the development of continuous glucose monitoring education modules based on best practices. The intervention was chosen by this DNP candidate to improve the registered nursing staff’s skills regarding pregnant women with diabetes management using continuous glucose monitoring. The goal of the education modules was to increase registered nurse knowledge on how to manage blood glucose of pregnant women with diabetes who use CGM device technology. Secondary goals of the education modules were to decrease episodes of hypo- and hyperglycemia, to safely decrease HbA1c levels during pregnancy, and to increase the number of referred patients utilizing CGM device technology. The education modules included PowerPoint slides on CGM devices and report interpretation for clinical decision-making.

The education modules included case studies to guide clinical decision-making. The modules also included evidence-based practice guidelines provided by the American Diabetes Association, CGM education and training principles of the Association of Diabetes Care and Education Specialists, CGM device manufacturer user guides, and a review of the new insulin titration protocol. Pictures of CGM reports, trends, and blood glucose values were reviewed. The PowerPoint slides were reviewed by the student nurse practitioner who has experience using CGM devices and interpreting reports to make insulin dose changes. Institutional and
departmental leadership reviewed the guidelines and parameters by which registered nurses provided patient care. Registered nurses called patients weekly to review CGM Time in Range (TIR) report, assess dietary intake and physical activity, and titrated insulin dosages based on CGM Time in Range report interpretation using the new protocol. Management participated in the review and development of guidelines and parameters based on the American Diabetes Association clinical practice guidelines, Medtronic Guardian CGM and Dexcom G6 user manuals by approval of institutional leadership. A team of registered nurses were recruited to assist with CGM education and evaluation of the nursing staff. The project team used Microsoft Teams to communicate progress on their individual contribution, needs, and requests to ensure the project was completed within budget and on time. The project benefited all insulin-dependent diabetes patients currently utilizing CGM device technology during pregnancy in the Northern California healthcare maintenance organization region.

**Continuous Glucose Monitoring Training**

Registered nurses completed four online training modules on CGM device technology and reporting software interpretation. Module one reviewed the Medtronic Guardian CGM device and CareLink software basics, the Dexcom G6 CGM device and Clarity software basics, CGM terminology, blood glucose report selection, and blood glucose report interpretation. Module two discussed CGM documentation and communication of reporting data to providers and methods for sharing data with interdisciplinary team members. Module three introduced the new insulin titration protocol for patient’s using multiple daily injections. Module four provided the registered nurses the opportunity to participate in a case study to correctly identify pertinent
blood glucose data and apply the new CGM protocol to titrate insulin for pregnant women with diabetes. See Appendix J for an explanation of the online training modules.

**Study of the Intervention**

**GAP Analysis**

After reviewing local resources, infrastructure, and processes, there was no program available to provide care for insulin-dependent women using CGM during pregnancy. The current practice of deferring insulin titration for pregnant women using CGM device technology during pregnancy to the perinatologist delayed patient care and limited the registered nurse from working at the top of their licenses. A second gap was identified that involved the variances in insulin-dependent diabetes education of the nursing and interdisciplinary staff. For example, when providing standard care to pregnant insulin-dependent women, some nurses titrated insulin up to the maximum dose allowed within the protocol (20%), but some nurses were more conservative and titrated insulin near the minimum dose (10%). This flexibility within the existing protocol was not evidence-based, nor did it fit the diabetes management protocol for provision of safe, high-quality diabetes care across the continuum of care, and could not be the basis of the CGM device and diabetes management project. The conservative approach to insulin-based care was based on fear of the unknown in terms of risks associated with hypoglycemia and a lack of confidence on behalf of the nurse. (See Appendix B).

**Stakeholders**

The stakeholders were management, leadership, physicians, advanced practice clinicians, and registered nurses. Management was a major stakeholder with significant influence, high impact and importance, with the ability to block the project, requiring immense engagement to
keep the project on track. Institutional leadership was a stakeholder of high influence, high impact and importance, with the ability to contribute or block the project, and took minimal engagement to keep the project on track. Physicians were stakeholders with some influence, low impact and influence, but of high importance, with some contribution, with no ability to block the project, and took little engagement to keep the project on schedule. Lastly, registered nurses were key stakeholders of high impact, importance, and influence who made high contributions, with no ability to block the project, requiring a significant amount of engagement to keep the project on schedule. (See Appendix C).

**SWOT Analysis**

The SWOT analysis project management tool identified areas of improvement, provided information to the project manager, ensured the project was completed on time, within budget, and helped to alleviate risks associated with tasks (Lim, 2012). The SWOT analysis for the CGM and Diabetes Management project identified several strengths, weaknesses, opportunities, and threats, which are described below.

**Strengths**

The strengths associated with the CGM and Diabetes Management project included increased confidence and competence among the registered nurses, expediency of care provided to patients using CGM technology, increased patient safety by decreasing in the number hypoglycemic episodes which was a provision of the 16-hour nursing support system, and the utilization of SMART goals in the project management of the assigned tasks. Expediency of care was identified as a strength of the CGM and Diabetes Management project because it minimized
risk by offering a seamless delivery of care through integration, coordination, and utilized the interdisciplinary team approach in project management.

Healthy People 2020 identified patient safety and quality as a leading health indicator and provided an evidence-based resource summary on improving the outcome of pregnancy and enhanced perinatal health through quality, safety and performance initiatives (healthypeople.gov). This resource provided the evidence necessary for offering 16-hour nursing support to vulnerable populations. SMART goals utilization was identified as a strength because when referenced in relationship to project management, the ability to successfully achieve goals was enhanced.

Weaknesses

The weaknesses were identified as the variability of CGM and diabetes management and insulin titration by the nurses, patient compliance with weekly phone calls, lack of an increase in patient census, and the limited supporting evidence in the literature because a project proposal of this type was unprecedented. Patients were less likely to adhere to nursing advice when historically, care was provided by perinatologists or diabetes endocrinologists. Patients typically did not answer the registered nurse’s call when trust was not established or when patient’s felt the service was not beneficial because the nurse was unable to titrate insulin dosages based on the CGM reports. Expanding the diabetes management during pregnancy program to CGM users was hypothesized to inversely increase the patient census when the project was supported by institutional leadership; however, this did not occur. Lastly, the lack of supporting evidence in the literature due to the unique nature of this project was a weakness when information was presented to stakeholders.
Opportunities

The opportunities were reduced hypo- and hyperglycemic episodes, increased patient safety, enhanced clinical decision-making, increased confidence and clinical competence among the registered nurses, garnered institutional leadership and provider support, the utilization of interdisciplinary teamwork, program recognition and modeling, a service provided to a vulnerable population, and the utilization of evidence-based standards. The implication for change varied and served many purposes. Implementation of this project eased congestion in the clinic and garnered perinatologists’ support. As this project provided a valuable service to a vulnerable population by utilizing evidence-based standards and provided recognition to the institution as a model for other healthcare systems to follow in the future.

Threats

The perceived threats to the CGM and Diabetes Management project included resistance from the registered nurses, lack of sponsor support, provider resistance, and pushback from competing subspecialty units. The threat that was most anticipated was resistance from registered nurses. This threat was highly expected because registered nurses expressed concern with the increased work involved with previous projects. Registered nurses were resistance to change and voiced opposition to the increased responsibilities and workload as they learned a new practice care delivery system. However, with transparency, clear communication, and adequate training, this threat was overcome.

Provider resistance was expected from providers who lacked knowledge of the unit’s expertise in perinatal glucose monitoring, lack of project objectives, and lack of understanding the potential benefits to the population being served. Pushback from competing subspecialty
clinics were anticipated because they perceived the project was taking responsibilities and patients away from the services they provided. One such subspecialty clinic was the Diabetes Clinic, which operates at major hospital satellites in the perinatology clinics throughout the healthcare institution’s Northern California region. These subspecialty clinics operate independently of each other and often did not refer their most complicated pregnant insulin-dependent patients using CGM unless care involved only routing collected blood glucose data from the patient to the Diabetes Clinic.

However, with education on the benefits of the project, which closed the CGM and diabetes management gap, the perinatologists in the Diabetes Clinics realized the CGM and Diabetes Management During Pregnancy project provided quality, safe, evidence-based care. Lastly, the lack of sponsor support threat was evident by resistance from the registered nurses and providers, and pushback from competing subspecialty clinic perinatologists that eventually were overcome. (See Appendix D).

**Work Breakdown Structure**

The Work Breakdown Structure (WBS) provided a breakdown of all the steps of the project. The Continuous Glucose Monitoring and Diabetes Management During Pregnancy program consisted of five phases. Phase One was the initiation phase where meetings with leadership and management took place to discuss the project proposal. Phase Two involved the planning phase of the project. The project manager worked closely with management to select key team members and oversaw the development of the kick-off meeting. Phase Three occurred in conjunction with the first step of Lewin’s Theory of Change of unfreezing, and involved the planning and development of the policies, procedures, and the provider-developed insulin
titration protocol of the project with institutional leadership and management using ADA clinical practice guidelines, and CGM device user manuals. Phase Four, also step two of Lewin’s Theory of Change, initiated the registered nurse education and training on CGM technology and report interpretation. Phase 5 and step three of Lewin’s Theory of Change began with the implementation of the project pilot, analysis, discovery, acceptance of results and ultimately archiving of data. (See Appendix E).

**Budget**

The budget was based on the salaries of the registered nurse’s hourly wage. The education meetings took place during Microsoft Team meetings prescheduled with the assistance of management and the project manager. Microsoft Teams provided a platform to meet regularly, within strict timeframes, with limited costs, and by continued adherence to the social distancing policy currently in place. The average hourly wage for a registered nurse was $77.00 per hour. There were 36 registered nurses who were invited to participate in the education meetings. The total for all training sessions was budgeted at $2772.00, however due to the COVID-19 temporary work from home policy change, the nurses completed the CGM education and training modules at home independently. This ultimately cost the unit zero dollars. (See Appendix F for the estimated budget prior to the COVID-19 temporary work from home policy enactment).

**Communication Plan/Matrix**

Microsoft Teams was used as the communication board method of communication between the project manager, leadership, and team members. The supervising faculty chair was provided updates from the communication board as required and stated on the
DNP Statement of Non-Research Determination Form (see Appendix G). The communication board was customized for each team member, improving communication board utilization and reporting. The communication board ensured that each team member knew their responsibility, held each team member accountable, and provided transparency for leadership. Leadership was well informed of the scope of the project, the timeframe for completion of the project, accurate costs of the project, met stakeholder’s expectation by displaying push back from the project manager. Transparency provided accuracy and led to improved decision-making. Communication board reporting was an important concept of the project management. The benefit of current, accurate, and relevant communication board reporting required that updates were completed daily because it held team members accountable for the scope, time, and costs of the project. One of the benefits of utilizing communication board reporting was the customization to each individual team member’s needs. Therefore, team members only needed to access areas of the communication board that related to their individual contribution, as all team members were well informed of progress during weekly Microsoft Team meetings. To mitigate planning and decision-making, weekly Microsoft Teams meetings were held to bring all team members together for discussions related to data collection and fulfilled request for feedback from stakeholder and team members. Weekly Microsoft Team meetings provided opportunities to ask important questions and overcome obstacles. (See Appendix H for the communication board method).
Measures

Smart Goals

To measure outcome goals, this project used the SMART goal template. The specific goal of educating the training the registered nurses for required analyzing their level of readiness and education. The resources to provide the education were created. Each registered nurse was equipped with a computer, Microsoft Teams access to facilitate communication, and management support for the pilot.

The primary measurement tool identified for this project was the qualitative data retrieved and analyzed from the Qualtrics pre- and post-surveys given to the registered nurses upon completion of the four modules. The secondary outcome measures were the HgbA1c <7.0 percent and 50% reduction of hypoglycemic episodes of patients referred to the program. The specified goal of safely improving patient glycemia and expanding diabetes management to include CGM knowledge would empower the registered nurses to care for this population, and accurately adjust insulin dosages using the CGM device reports along with the glucometer blood glucose readings.

The goal to improve glycemic control during pregnancy using CGM device technology while also reducing episodes of hypoglycemia was attainable. After assembling a team to work together to identify potential pilot participants, patients eventually were referred to the unit and assigned to a registered nurse for weekly telephone appointments. This contact required no special equipment of expenditures for the registered nurse or the patient.
Relevancy of the stated goals was determined because the strategy for e-learning fit within the current temporary work from home policy as a result of the COVID-19 pandemic. The defined goals are time based because the training and education the registered nurses received now allows them to take immediate action when identifying abnormal glucose values on the CGM report.

Each nurse who agreed to participate in the pilot understood the end date for achieving the goals and understood the time and structure of the pilot. Once Northern California HMO members were referred to the implementation unit with a confirmed IUP, the registered nurses applied the learned CGM technology, diabetes during pregnancy support, and medication titration protocol via weekly telephone appointments. It is of my opinion, and the reason for the pilot project, that the implementation unit could do more to provide care to insulin-dependent women who use CGM device technology. This can be accomplished by interpreting Time in Range reports and titrating insulin dosages when hypoglycemic episodes are identified. It is possible to reduce HgbA1c levels safely during pregnancy by using the ADA recommended guidelines. Prior to enrollment, members had a baseline HbA1c drawn, and subsequent levels drawn each month until delivery or at the end of the pilot, whichever came first. The timeline for the pilot project was for a maximum of twelve weeks. These goals were realistic and feasible because the implementation unit had the staff, time, and support of leadership at project implementation.
Analysis

Qualtrics was used to provide gap analysis, and pre- and post-surveys. The registered nurses were given a gap analysis survey to determine their CGM device technology and report interpretation educational needs. Information gathered from the Qualtrics were used as the basis for the continuous glucose monitoring blood glucose and CGM report interpretation training modules. After CGM training, registered nurses took a posttest to measure hypo- and hyperglycemia trending and recognition, appropriate blood glucose report selection and data interpretation. Efficacy of continuous glucose monitoring training, and the knowledge gap assessment was measured by comparing the pretest and posttest results. Based on the outcome answers, education targeted the needs of the registered nurses and was be beneficial during the pilot. Lastly, the post-test measured the level of understanding of the education provided. Any information that was not understood or required remediation was evident on the post-test survey. See Appendix I for the Qualtrics pre-test survey.

Ethical Considerations

While the goal of this project proposal was to provide information and data supporting the need to provide quality care to a vulnerable population, leadership based their decision-making on qualitative and quantitative analytics. The primary objective was to increase the knowledge of the registered nurses in CGM device technology. Evidence supports the on-going education of clinicians who manage the blood glucose of patients using CGM device technology. IRB consideration was not necessary for this
project as it was a quality improvement project that changed practice to provide better care for patients. See Appendix G for the DNP SOD form.

In the Jesuit tradition at USF, we are taught just as the Lord taught Cain in Genesis 4:9 about the role of honesty and respect in our lives. When the Lord asked Cain where Able was, Cain responded “Am I my brother’s keeper?” As a nurse, the answer is a resounding “Yes!” The American Nurses Association Code of Ethics encompasses three provisions that specifically apply to this project: Provision 3.4 explains professional competence in nursing practice, Provision 5.5 further encourages maintenance of competence and professional growth, and last, Provision 7.2, which details contributions through developing, maintaining, and implementing professional practice standards in the nursing profession. This project accomplishes and adheres to all the aforementioned provisions and in the spirit of the Jesuit teachings at the University of San Francisco’s School of Nursing and Health Professions.

Results

CGM and Diabetes Management During Pregnancy Pre-Education Survey

The CGM and diabetes management during pregnancy pre- and post-education and training surveys were created for this project using Qualtrics. The pre-education and training survey consisted of six questions and was sent to 30 registered nurses in the unit to determine the level of interest for the pilot project. Of the 30 registered nurses, nine completed the survey before the start of the pilot, nine didn’t respond, five declined to take the survey but verbalized their interest in the CGM and education and training modules, four retired before completing the survey, one retired after submitting the survey, one transferred to a different inpatient unit, and
one went on medical leave of absence and did not complete the pre-education and training survey. See Appendix M for the post-education and training survey.

**CGM Education and Training Modules**

Four modules were created to educate the registered nurses on CGM technology and to training them on the NP-developed insulin titration protocol. Module One introduced CGM devices used during pregnancy, recognition of two CGM devices, instructed on accessing CGM software websites for viewing CGM data and reports, understanding basic CGM terminology, including how CGM works, appropriate blood glucose report selection, and interpret blood glucose reports to aid in clinical decision-making about insulin titration.

Module Two established the agreed upon professional documentation and data sharing requirements for CGM and diabetes management. The professional documentation standards were agreed upon during the Advanced Technologies & Treatment for Diabetes Congress commissioned by leading experts in 2016 and affirmed in 2019 (Battelino, et al., 2019). The module explained professional CGM documentation, application of the knowledge of professional CGM standards to documentation in the HER, developing simplistic weekly goalsetting for patients, and communicating appropriate recommendations to providers.

Module Three introduced the NP-developed insulin titration protocol and a new practice and procedure for the pilot project. The NP-developed protocol is based on prior ACOG and ADA guidelines used to develop the existing insulin titration protocol approved for patients referred to the Home Glucose Monitoring Program. This protocol is referred exclusively for pregnant women with diabetes who are referred with CGM during pregnancy, and who control their blood glucose using multiple daily injections of rapid-acting insulin such as Lispro or Humalog, fast-
acting insulin such as Regular insulin, and intermediate-acting insulin such as Humulin-N, or NPH. The protocol was developed to assist providers who refer patients using CGM with the expectation that registered nurses will titrate insulin based on daily fingersticks for fasting blood glucose, and 1-hour postprandial for breakfast, lunch, and dinner. However, CGM allows the registered nurse to view blood glucose that is collected every 5 minutes, for up to 255 blood glucose values in 24 hours, viewable on the CGM software website. The NP-developed protocol uses the patient’s BMI to titrate insulin dosages based on increases or decreases of 10-20% of the previous insulin dose.

In Module Four, registered nurses identified CGM devices, accessed the correct CGM software website, selected the appropriate blood glucose report, interpreted blood glucose reports in comparison to the SMBG, discussed lifestyle, dietary, and medication management causes for hypo- or hyperglycemia, set simplistic weekly blood glucose goals, transcribed professional documentation for sharing with providers. Module Four discusses continuous glucose monitoring and diabetes management during pregnancy by practicing CGM management in a case study format. See Appendix J for the four education and training module topics. See Appendix L for the Module PowerPoint slides.

**CGM and Diabetes Management During Pregnancy Post-Education Survey**

Of the remaining staff, 23 registered nurses were invited to participate in the four education modules and complete the post-education survey. At the time of this paper, 17.4% of the registered nurses completed the post-education survey although 52.2% of respondents completed all four modules and began using the new protocol in practice during the pilot. Survey results indicated 100% felt the CGM module education level was appropriate for their learning,
100% reported the graphics and module transcripts enhanced their learning, 50% reported their knowledge of CGM and diabetes management during pregnancy increased since completing the CGM education and training modules, 100% felt confident providing care to patients using multiple daily injections and CGM as adjunctive therapy after completing the CGM modules, and 100% reported a clear understanding of the NP-developed CGM insulin titration protocol after completing the CGM education and training modules. See Figure 4 and Figure 5 for statistical data.

**CGM and Diabetes Management During Pregnancy Pilot**

Pilot participants were selected based on referral criteria from the primary obstetrical provider. Qualified participants were selected starting in June 2020 due to the limited number of CGM users during pregnancy in the region. At the time of enrollment, the participants ranged from eight weeks to 13 weeks gestation and were enrolled for an average of 16 to 25 weeks. Three patients were induced at 38 weeks gestational age in accordance with ACOG guidelines. The referral criteria are confirmed pregnancy viability, enrollment HgbA1c, glucometer and supplies, dietary consultation with a registered dietician, smartphone or CGM receiver, CGM device, basal insulin and preprandial insulin prescription with refills available. The pilot participants were asked to give the login information for the CGM device platform for weekly review during the telephone appointments. The patients were scheduled for weekly telephone appointments with the registered nurses to review multiple daily injection (MDI) blood glucose values to compare to the CGM sensor glucose values. If the patient did not answer the phone for their scheduled telephone appointment, the primary obstetrical provider was notified of the patient’s non-engagement and the patient was expected to call back upon receipt of any
voicemail or secure message sent by the registered nurse. After three weeks of non-engagement, the patients would then be discharged from the pilot and program.

In 2020, a total of 10 patients using a CGM device as conjunctive therapy with diabetes management were referred to the program. Nine of the 10 patients were pregnant and were enrolled in the project pilot. One patient was referred to the program but was not included in the pilot project because she was not currently pregnant, although she was prescribed a CGM device for use in the preconception counseling program. The registered nurses assigned to her management plan participated in the CGM education and training modules and reported positive responses on the post-education and training surveys.

Overall, three patients enrolled in the pilot completed the program and delivered healthy infants, three are still pregnant and enrolled in the program, and three were discharged from the program due to non-engagement. Non-engagement is defined as three consecutive weeks without contact with the registered nurses and is a departmental policy requirement. Once discharged from the pilot and the program, the patients were referred to the primary obstetrical provider for continued coordination of care. These patients will be offered re-enrollment in the program when they are ready to be reinstated.

**Nursing Interventions**

The four options of nursing intervention were 1) none needed, 2) registered nurse adjusted insulin using the NP-developed insulin titration protocol and routed to the obstetrical provider for review, 3) registered nurse routed to obstetrical provider for insulin adjustment recommendations based on patient concern, and 4) registered nurse adjusted insulin using the NP-developed insulin titration protocol for a maximum of 20%, and routed to the obstetrical
provider for additional adjustment greater than the protocol allows. See Appendix K and Table 1 for the NP-developed insulin titration protocol.

**Starting Average Hemoglobin A1c**

The highest starting HgbA1c was 9.8% while the lowest was 4.7%. As a departmental policy, patients complete the HbgA1c lab test monthly. All participants successfully completed this requirement as ordered. Of the patients who successfully continued the pilot for the duration of their pregnancies, all showed improved HgbA1c except one. The average starting HgbA1c was 7.23% while the average final HgbA1c was 5.83%. While a decrease in HgbA1c was expected, as the literature supports, the speed at which the benefits of CGM during pregnancy became evident was a surprise. The pilot demonstrated a decrease of 1.4 percentage points in HgbA1c for these women. See Figure 6 for graphical data.

**Hypoglycemia**

Two of the nine participants had a history of regular hypoglycemic episodes prior to enrollment. One of the two participants experienced severe hypoglycemia requiring hospitalization prior to pregnancy, complicating diabetes management due to extreme hypoglycemia unawareness and an increased risk of nocturnal hypoglycemia.

Two of the nine participants experienced daytime hypoglycemia during the first two weeks enrolled in the pilot related to skipping the mid-morning snack and increased physical activity. These episodes were captured on the CGM report and immediately corrected by the registered nurse after decreasing the morning basal insulin. The intervention was based on the NP-developed protocol, resulting in episodic hypoglycemia absence for the duration of the pilot.
In total, all nine CGM and diabetes pilot participants reported zero episodes of hypoglycemia for the duration of the pilot after receiving education from the registered nurses on CGM report interpretation and after the CGM alarm settings were changed in accordance with ACOG and ADA recommendations for CGM use during pregnancy. Hypoglycemia avoidance was discussed at each weekly telephone appointment.

**Secondary Outcome Measures**

The secondary outcome measures were related to maternal and fetal wellbeing. Although these two components of care were not intended as a primary measurement during the pilot, literature identified the need for ongoing research to establish them as primary outcome measures. As a result of close surveillance of blood glucose with MDI, glucometer blood glucose, and CGM sensor glucose, maternal outcomes revealed two of the three pilot participants who delivered did so vaginally. All three infants were delivered with a normal fetal weight of less than 4,000 grams as recommended by ACOG, and none required neonatal intensive care unit admission for hypoglycemia. One pilot participant delivered via cesarean section due to complications of preeclampsia that was unrelated to the CGM and diabetes management during pregnancy care received during the pilot.

**Final Average Hemoglobin A1c**

All but one patient showed a decrease in HgbA1c by the end of the pilot or at delivery. The final average HgbA1c was 4.49% among the pilot participants. The HgbA1c improvement score was calculated by subtracting the starting average HgbA1c from the final HgbA1c for a total improvement score of 2.81 percentage points. The improvement score was achieved by
successfully implementing the NP-developed insulin titration protocol without inducing signs or symptoms of hypoglycemia. See Figure 4 for the hemoglobin A1c comparison.

Discussion

Summary

The specific aim of the pilot was to reduce the rate of hypoglycemia for pregnant women who use CGM during pregnancy by 50% in the first 3 weeks of the start of the pilot. Further, the goal of reducing the HgbA1c level at the end of pregnancy or the end of the pilot was also achieved, improving maternal and fetal outcomes as an unintended secondary measure. Evidence is compelling and strong that registered nurses should be trained to use CGM device technology. With training, registered nurses work within their scope of practice to use CGM device technology along with a provider-developed protocol when caring for this population. The evidence contributes to the advocacy that all pregnant women with diabetes should have access to a CGM device to reduce the burden of diabetes on pregnancy, but more studies are needed to determine long term benefits and neonatal and maternal outcomes.

Interpretation

As evidenced in the studies examined for this pilot, there were no established standard of care utilizing CGM technology and preprandial blood glucose goals. The ADA’s postprandial blood glucose recommendations, in conjunction with clinical CGM targets developed by the Advanced Technologies & Treatment for Diabetes Congress provide some evidence that CGM can improve BG control, limit blood glucose variability by allowing early intervention, reduce episodes of hypo- and hyperglycemia, and is safe when used during pregnancy.
Although standardized procedures utilizing CGM are needed for nurses taking care of pregnant women with diabetes, no such established standardization existed prior to the pilot. The pilot evidence indicates that CGM can help achieve an adequate HgbA1c when used as adjunct therapy with self-management blood glucose (SMBG) without increasing the risk of hypoglycemia during pregnancy. CGM greatly reduces the burden of diabetes during pregnancy by reducing the number of fingersticks required to accurately and safely titrate insulin. CGM is a reliable method for making clinical decisions about insulin and glycemic goals. CGM use has not been associated with adverse outcomes during pregnancy and reduces the lack of hypoglycemia awareness by accurately predicting hypoglycemia by up to one hour before an occurrence.

CGM can accurately identify low blood glucose trends, can be used effectively in conjunction with standard care during pregnancy to aid in the treatment of diabetes in pregnancy. The reviewed articles share the common conclusion that CGM data accurately report blood glucose values when compared to SMBG data. The literature recommends CGM as adjunct therapy for identifying and correcting hypo- and hyperglycemia, found comparable outcomes to women without diabetes during pregnancy, and used the same blood glucose target goals of 70 mg/dl to 180 mg/dl as recommended by the American Diabetes Association. The pilot adopted the literature evidence in the clinical decision-making tool that was also part of the innovative protocol for insulin titration used by the registered nurses.

Several articles specifically advocated for registered nurses to be trained on report interpretation of CGM devices, and highlighted barriers to expanded CGM use due in part to lack of diabetes specialist education and training (Battolino, et al., 2019; Fonseca, et al., 2016; Hollis, et al., 2014; Berget & Wyckoff, 2020). The strongest piece of evidence reviewed was the
article discussing the Advanced Technologies & Treatment for Diabetes Congress that was commissioned to develop clinical CGM targets (Battolino, et al., 2019). This article was used as a basis for developing a protocol to guide clinical decision-making because it compared two of the most common CGM devices, the Medtronic Guardian and the Dexcom G6 (see Table 3). Researchers (Battolino, et al., 2019) suggested clinicians and patients be trained to accurately interpret the time in range report to make clinical decisions and insulin titration. The intent of the panel was to provide clinicians with the metrics needed to obtain and interpret current blood glucose levels and adjust therapy accordingly.

**Limitations**

The limitations of the project were the small sample size of the cohort, limited participation of the registered nurses, the limited timeframe of the pilot, and non-engagement of three of the nine pilot participants which led to discharge from the program. The cohort sample size was small due to the lack of CGM during pregnancy users enrolled in the healthcare maintenance organization. Some primary obstetrical providers prefer to manage the blood glucose of their patients without referral to the program, while some patients prefer to be managed in clinic weekly and chose to not use the telephone appointment capabilities of the registered nurses, however, the specified statistics were not available for analysis in this project.

The pilot project discussion began with leadership in December 2019. The decision was made to start screening patients during the recruitment process in June 2020 when the first CGM during pregnancy users were referred to the program. The recruitment process began before the pilot implementation since patient are typically referred very early in the pregnancy, and because referral to the program historically is scarce.
Considerable literature is limited of long term random controlled trials involving CGM use during pregnancy and are on-going. For this reason, CGM education and training modules and the NP-developed insulin titration protocol was created specifically for the pilot. As the on-going studies progress, new information will be elicited. A major weakness of the studies reviewed for the pilot was that none discuss maternal and fetal outcomes as an important theme worthy of research. Among the articles, researchers (Polsky & Garcetti, 2017) determined more studies are needed to conclude long term benefits and neonatal and maternal outcomes. The link of nocturnal hyperglycemia to that of large for gestational age (LGA) neonates was attempted by Battolino, et al. (2019) but the study authors failed to specifically correlate the data as such, concluding with a need for more studies. Limiting the data by not conducting follow up studies of this important dataset means clinicians will continue to work to decrease daytime hyperglycemia without knowing if basal insulin should be titrated to decrease nocturnal hyperglycemia, potentially preventing LGA neonates who require intensive care following birth.

Conclusions

The findings from the pilot project, while supported by the literature, indicate that the interpretation of continuous blood glucose reports is an essential function of registered nurses who provide care for pregnant women who use CGM with diabetes. However, to perform this essential function during the pilot, registered nurses were provided a protocol to follow and CGM education and training to interpret the critical CGM report data. A lack of CGM education and training was a barrier that subsequently delayed care and had a negative impact on the patient’s blood glucose control during pregnancy. As a result of the pilot program, pregnant women using CGM devices as adjunctive therapy to MDI diabetes management experienced
decreased episodic hypoglycemia, zero episodes of nocturnal hypoglycemia unawareness, improved HgbA1c, and vaginal delivery of normal weight infants who did not require neonatal intensive care unit stay.

The following recommendations are made for providing evidence-based care to pregnant women who use CGM device technology during pregnancy. Nurse practitioners possess the skills, education, training, and leadership experience to train registered nurses on CGM report interpretation. CGM education and training should be made widely available by nurse practitioners to all registered nurses who provide care for patients who use CGM devices. Registered nurses should be allowed to perform independent and dependent functions when using a nurse practitioner-developed protocol to provide care for pregnant women with diabetes who use continuous glucose monitoring during pregnancy. Evidence supports educating and training registered nurses on continuous glucose management device technology to improve blood glucose and to aid in the clinical decision-making process.
References


http://doi.10.1016/S0140-6736(17)32400-5


## Appendix A

### Review of Evidence Grid

Key: Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool LOE: level of evidence (LoBiondo-Wood & Haber)

<table>
<thead>
<tr>
<th>Category (Level Type)</th>
<th>Total Number of Sources/Level</th>
<th>Overall Quality Rating</th>
<th>Synthesis of Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level I</strong></td>
<td></td>
<td></td>
<td>1. CGM training should be made widely available to clinicians such as nurses and NPs, Formal certification would add to more barriers and isn’t necessary. Clinician training should be expanded.</td>
</tr>
<tr>
<td>■ Experimental study</td>
<td></td>
<td>A: High Quality</td>
<td>2. Dexcom G6 CGM is a reliable tool during pregnancy. Accuracy of CGM results associated with placement on upper arm. CGM may be beneficial to women with other types of DM. Limitation is small sample size (32 pregnant women 18-34 yrs old; 15 T1D using MDI; 5 T1D using CSII; 3 T2D, 9 GDM), (Castorino, et al., 2020).</td>
</tr>
<tr>
<td>■ Randomized controlled trial (RCT)</td>
<td></td>
<td></td>
<td>3. TIR streamlines data interpretation and provides more information than A1c alone and facilitates safe and effective therapeutic decision-making within glycemic parameters. TIR should be increased during pregnancy as quickly as possible. Clinician inexperience in data interpretation plays a role in the underutilization of CGM use during pregnancy. (Battelino, et al., 2019).</td>
</tr>
<tr>
<td>■ Systematic review of RCTs with or without meta-analysis</td>
<td></td>
<td></td>
<td>4. This study analyzed data of 132 women on the impact of CGM on maternal, fetal, and neonatal outcomes by attempting to explain the trimester-specific timeframe contributing to LGA by identifying BG variability. There was no significant difference in mean A1c levels among mothers w/ LGA infants compared to those w/o LGA infants; DM pregnancies were clinically well controlled. (Law, et al., 2015).</td>
</tr>
<tr>
<td>■ Explanatory mixed method design that includes only a Level I quantitative study</td>
<td></td>
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<tr>
<td><strong>Level II</strong></td>
<td><strong>Level III</strong></td>
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<td>--------------</td>
<td>--------------</td>
<td></td>
<td></td>
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<tr>
<td>■ Quasi-experimental studies</td>
<td>■ Nonexperimental study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis</td>
<td>■ Systematic review of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Explanatory mixed method design that includes only a Level II quantitative study</td>
<td>■ Qualitative study or meta-synthesis</td>
<td></td>
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<tr>
<td></td>
<td>■ Exploratory, convergent, or multiphasic mixed-methods studies</td>
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<tr>
<td></td>
<td>■ Explanatory mixed method design that includes only a level III Quantitative study</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A: High Quality</td>
<td><strong>3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Lack of training for healthcare providers. CGM is safe in pregnancy when used in conjunction with RGM. CGM is beneficial as adjunctive glucose management tool in pregnancy (Polsk &amp; Garcetti, 2017).</td>
<td>1. Observational cohort study. CGM’s role in improving TIR, improved fetal outcomes. LGA is semester specific. Lower A1c in first trimester, with higher BG variability and less TIR associated with LGA (Kristensen, et al., 2019).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CGM can effectively be used in patients using MDI or CSII. TIR has been standardized as 70-180 mg/dl and is established as a specific target range for pregnancy. CGM use is correlated with a reduction of DM complications. (Gabbay, et al., 2020).</td>
<td>2. Reduced in-person clinic visits d/t CGM and RGM lowers costs. HbA1c is naturally lower by 0.5% during pregnancy d/t short lifespan of RBC, increased erythropoiesis. (Stewart, et al., 2019).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 82 women completed the study which demonstrated the physiological importance of tight glycemic control in minimizing perinatal complications. CGM in pregnancy identified significant daily glucose variability otherwise missed by standard care (SMBG). (Mazze, et al., 2012).</td>
<td>3. Explains the pathophysiology of GDM, insulin resistance, glucose intolerance, and metabolic dysfunction as contributing factors to variable blood glucose during pregnancy. Cites ACOG and other governing body guidelines and recommendations, give extensive background on CGM use and benefits. (Carreiro, et al., 2018).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category (Level Type)</td>
<td>Total Number of Sources/Level</td>
<td>Overall Quality Rating</td>
<td>Synthesis of Findings Evidence That Answers the EBP Question</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Level IV</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Opinions of respected authorities and/or reports of nationally recognized expert committees or consensus panels based on scientific evidence</td>
<td>2</td>
<td>B: Good Quality A: Good Quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. CGM was more helpful in T1D. and demonstrated postprandial hyperglycemia and nocturnal hypoglycemia that was either not evident or underestimated by SBMG. CGM improves clinical decision-making; most common change was decreasing long-acting or intermediate-acting insulin d/t previously undetected nocturnal hypoglycemia. (Sung, Taslimi, &amp; Faig, 2012).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. CGM training should be made widely available to clinicians such as nurses and NPs. Formal certification would add to more barriers and isn’t necessary. Clinician training should be expanded. (Fonseca, et. al, 2016).</td>
</tr>
<tr>
<td><strong>Level V</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Evidence obtained from literature or integrative reviews, quality improvement, program evaluation, financial evaluation, or casereports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Opinion of nationally recognized expert(s) based on experiential evidence</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Recommendations based on evidence synthesis and selected translation pathway**

Evidence is compelling and strong that registered nurses should be trained on CGM device technology. Specialized certification is not necessary and is a barrier to expanding the use of CGM during pregnancy. With training, registered nurses work within their scope to use CGM device technology in their work when caring for this population. Recommendation to conduct a pilot study to test implementation of a new protocol to be used by registered nurses to titrate insulin dosages for women using CGM as adjunct therapy to multiple daily injections to control diabetes during pregnancy. The implementation site is appropriate to test this pilot, is compatible with the cultural values and norms as recommended by industry experts, is consistent with practices of the unit and organizational priorities. The implementation pilot is feasible and has stakeholder support, funding, resources, and approval from unit leadership.
Appendix B

GAP ANALYSIS

<table>
<thead>
<tr>
<th>Best Practice Strategy</th>
<th>Institution Practice Strategy</th>
<th>Barriers to Best Practice Implementation</th>
<th>Will Implement Best Practice (Yes/No; why not?)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best Practice #1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Glucose</td>
<td></td>
<td>Management and Leadership Support</td>
<td>Yes</td>
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<tr>
<td>Monitoring and Diabetes</td>
<td></td>
<td></td>
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<tr>
<td>Management Program</td>
<td>No RPSC CGM Program Exists</td>
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<tr>
<td><strong>Best Practice #2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN Chronic Disease</td>
<td></td>
<td>CNA Union Contract and RN staff may lack support</td>
<td>Yes</td>
</tr>
<tr>
<td>Management Education and Training</td>
<td>New Hire Policy and Procedure Training</td>
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<td></td>
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## Appendix C

### GANTT

<table>
<thead>
<tr>
<th>Task</th>
<th>Assigned to</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>Discuss Project</td>
<td>DNP Candidate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Project Approval</td>
<td>Management</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Design Training Modules</td>
<td>DNP Candidate</td>
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<td></td>
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</tr>
<tr>
<td>Analyze Qualtrics Result</td>
<td>DNP Candidate</td>
<td></td>
<td></td>
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<tr>
<td>Present Results</td>
<td>DNP Candidate</td>
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<tr>
<td>Discuss Pilot</td>
<td>DNP Candidate</td>
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<tr>
<td>Pilot Implementation</td>
<td>RN Staff</td>
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<tr>
<td>Final Qualtrics</td>
<td>DNP Candidate</td>
<td></td>
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<tr>
<td>Analyze Final Qualtrics</td>
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<tr>
<td>Present Findings</td>
<td>DNP Candidate</td>
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# Appendix D

## SWOT ANALYSIS

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Continuity of care</td>
<td>• Less patient compliance</td>
</tr>
<tr>
<td>• Increased patient safety</td>
<td>• Unprecedented project proposal</td>
</tr>
<tr>
<td>• Convenience of TAV</td>
<td>• Increased patient census</td>
</tr>
<tr>
<td>• 16-hour unit support</td>
<td></td>
</tr>
<tr>
<td>• SMART Goals</td>
<td></td>
</tr>
<tr>
<td>• Numerous supporting evidences in literature</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce clinic visits</td>
<td>• RN resistance</td>
</tr>
<tr>
<td>• Interdisciplinary Teamwork</td>
<td>• Lack of Sponsor support</td>
</tr>
<tr>
<td>• Vulnerable population</td>
<td>• Provider resistance</td>
</tr>
<tr>
<td>• Utilize EBP standards</td>
<td>• Competing subspecialty units</td>
</tr>
</tbody>
</table>
## Appendix E

### Work Breakdown Structure

<table>
<thead>
<tr>
<th>LEVEL 1</th>
<th>LEVEL 2</th>
<th>LEVEL 3</th>
</tr>
</thead>
</table>
| 1 Postpartum Diabetes Management | 1.1 Initiation | 1.1.1 Evaluation and Recommendation  
1.1.2 Discuss Project Charter  
1.1.3 Deliverable: Project Charter Submission  
1.1.4 Sponsor Charter Review  
1.1.5 Signed/Approved Project Charter |
| 1.2 Planning | | 1.2.1 Preliminary Scope Statement  
1.2.2 Project Team Selection  
1.2.3 Project Plan Kickoff Meeting  
1.2.4 Project Plan Development  
1.2.5 Project Plan Submission  
1.2.6 Milestone: Project Plan Approval |
| 1.3 Execution | 1.3.1 Project Kickoff Meeting  
1.3.2 RN Requirements Verify/Validation  
1.3.3 Policy & Procedure Design  
1.3.4 Deliverable: P&P Submission  
1.3.5 Sponsor P&P Review  
1.3.6 Signed/Approved P&P  
1.3.7 RN P&P Training  
1.3.8 Go Live (Pilot) |
| 1.4 Control | 1.4.1 Project Management  
1.4.2 Project Status Meeting  
1.4.3 Risk Management  
1.4.4 Update Project Management Plan |
| 1.5 Closeout | 1.5.1 Procurement Audit  
1.5.2 Lessons Learned Session  
1.5.3 Update Files  
1.5.4 Gain Formal Acceptance  
1.5.5 Archive Files |
Appendix F

Proposed Budget

<table>
<thead>
<tr>
<th>Estimated Cost</th>
<th>Material/Resources</th>
</tr>
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<tbody>
<tr>
<td>$77.00 (36)</td>
<td>RN Paid Training: 1 hour</td>
</tr>
<tr>
<td>$0</td>
<td>Pretest (Qualtrics)</td>
</tr>
<tr>
<td>$0</td>
<td>Posttest (Qualtrics)</td>
</tr>
<tr>
<td>$0</td>
<td>Pretest (Qualtrics)</td>
</tr>
<tr>
<td>$0</td>
<td>Posttest (Qualtrics)</td>
</tr>
<tr>
<td>$0</td>
<td>Conference Room Reservation</td>
</tr>
<tr>
<td>$2772</td>
<td>Total</td>
</tr>
</tbody>
</table>
Appendix G

Doctor of Nursing Practice
Statement of Non-Research Determination (SOD) Form

The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E

General Information

<table>
<thead>
<tr>
<th>Last Name:</th>
<th>Beamish</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name:</td>
<td>Nicole</td>
</tr>
<tr>
<td>CWID Number:</td>
<td>20381945</td>
</tr>
<tr>
<td>Semester/Year:</td>
<td>Summer 2019</td>
</tr>
<tr>
<td>Course Name &amp; Number:</td>
<td>N7005 Population Health Leadership and Teamwork in Project Planning</td>
</tr>
<tr>
<td>Chairperson Name:</td>
<td>Dr. Loomis</td>
</tr>
<tr>
<td>Advisor Name:</td>
<td>Dr. Loomis</td>
</tr>
</tbody>
</table>

Project Description

1. Title of Project

Remote Glucose Monitoring and Continuous Glucose Monitoring Blood Glucose Report Interpretation in a Regional Perinatal Service Center staffed by nurses in a telehealth setting

2. Brief Description of Project

Clearly state the purpose of the project and the problem statement in 250 words or less.
3. **AIM Statement: What are you trying to accomplish?**

*Complete this statement:*

To increase the knowledge of nurses providing care to pregnant women referred using continuous glucose monitoring, remote glucose monitoring, and blood glucose report interpretation (process/outcome) from 0% (baseline %, rate, #, etc.) to 100% (goal/target %, rate, #, etc.) by 3 months (date, 3 - 6-month timeframe) for registered nurses at the implementation unit (population impacted).

4. **Brief Description of Intervention (150 words).**

The purpose of the project is to educate perinatal nurses on continuous glucose monitoring (CGM), remote glucose monitoring (RGM), and blood glucose (BG) report interpretation for women with gestational and chronic diabetes.

This is a major nursing practice change that will educate the nurses on CGM, RGM, and BG report interpretation using Medtronic CareLink and Dexcom Clarity platforms. For 18+ years, the nursing staff have titrated insulin for women during pregnancy using a strict protocol. Nurses do not currently titrate insulin for pump users because they do not have insulin pump certification, and most nurses at the service center don’t know how to interpret the CGM reports.

The intervention will be the creation of a CGM and RGM report interpretation algorithm that will allow the registered nurses to feel confident titrating insulin dosages. The new algorithm will be based on an existing algorithm of a 10% or 20% maximum insulin titration that relies upon the patient’s current BMI, hypoglycemic history, gestational age, and current insulin dosages.

4a. **How will this intervention be implemented?**

- Where will you implement the project?
- Attach a letter from the agency with approval of your project.
- Who is the focus of the intervention?
- How will you inform stakeholders/participants about the project and the intervention?

A pre-education survey will be given to the registered nurses to measure their confidence, knowledge, and degree of education needed to effectively implement the algorithm.

The project will be implemented at the implementation unit in Northern California.

The focus of the intervention are the registered nurses.

The stakeholders and participants will be informed about the project and the intervention by the project leader, unit director, unit manager, and department medical director the Northern California Region Perinatologists’ monthly meeting.
5. Outcome measurements: How will you know that a change is an improvement?

- Measurement over time is essential to QI. Measures can be outcome, process, or balancing measures. Baseline or benchmark data are needed to show improvement.
- Align your measure with your problem statement and aim.
- Try to define your measure as a numerator/denominator.
  - What is the reliability and validity of the measure? Provide any tools that you will use as appendices.
  - Describe how you will protect participant confidentiality.

Outcome measurements will be based on the post-education surveys given to the registered nurses and compared to the pre-education surveys to determine if an increase in nurse competence and knowledge exists within 3 months of implementation, with a goal of 100% of the nurses reporting an increase in competence, confidence, and knowledge of CGM, RGM, and BG report interpretation.
# DNP Statement of Determination

**Evidence-Based Change of Practice Project Checklist***
*The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E*

**Project Title:**
Remote Glucose Monitoring and Continuous Glucose Monitoring Blood Glucose Report Interpretation in a Regional Perinatal Service Center staffed by nurses in a telehealth setting

<table>
<thead>
<tr>
<th>Mark an “X” under “Yes” or “No” for each of the following statements:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>The aim of the project is to improve the process or delivery of care with established/accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The specific aim is to improve performance on a specific service or program and <strong>is a part of usual care.</strong> All participants will receive standard of care.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project is <strong>not</strong> designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does <strong>not</strong> follow a protocol that overrides clinical decision-making.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does <strong>not</strong> develop paradigms or untested methods or new untested standards.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does <strong>not</strong> seek to test an intervention that is beyond current science and experience.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project has <strong>no</strong> funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., <strong>not</strong> a personal research project that is dependent upon the voluntary participation of colleagues, students and/or patients.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: “This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board.”</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Answer Key:

- If the answer to all of these items is “Yes”, the project can be considered an evidence-based activity that does not meet the definition of research. IRB review is not required. Keep a copy of this checklist in your files.
- If the answer to any of these questions is “No”, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used: [http://answers.hhs.gov/ohrp/categories/1569](http://answers.hhs.gov/ohrp/categories/1569)

---

**DNP Statement of Determination**

**Evidence-Based Change of Practice Project Checklist Outcome**

*The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E*

**Project Title:**

Remote Glucose Monitoring and Continuous Glucose Monitoring Blood Glucose Report Interpretation in a Regional Perinatal Service Center staffed by nurses in a telehealth setting

☑ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). **Student may proceed with implementation.**

☐ This project involves research with human subjects and **must be submitted for IRB approval before project activity can commence.**

**Comments:** This project will not require IRB approval because no human subjects are needed to develop the nursing education protocol.

<table>
<thead>
<tr>
<th>Student Last Name:</th>
<th>Beamish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student First Name:</td>
<td>Nicole</td>
</tr>
<tr>
<td>CWID Number:</td>
<td>20381945</td>
</tr>
<tr>
<td>Semester/Year:</td>
<td>Fall 2019</td>
</tr>
<tr>
<td>Student Signature:</td>
<td>Nicole L. Beamish</td>
</tr>
<tr>
<td>Date:</td>
<td>5/228/2020</td>
</tr>
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</table>
Chairperson: Jo Loomis
Name: ________________________________  Date: ________________________________
Chairperson Signature: Jo Loomis
Date: 9/27/20

DNP SOD Review Committee
Member Name: ________________________________

DNP SOD Review Committee Member
Signature: ________________________________ Date: ________________________________
## Appendix H

### Communication Plan/Matrix

<table>
<thead>
<tr>
<th>Communication Matrix</th>
<th>DNP Candidate</th>
<th>Leadership</th>
<th>Management</th>
<th>Registered Nurses</th>
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<tbody>
<tr>
<td>Update Communication Communication Board</td>
<td>Daily</td>
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<td>N/A</td>
<td>Daily</td>
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<td>Conduct Staff Training</td>
<td>Will Provide</td>
<td>Advise</td>
<td>Advise</td>
<td>Will Receive</td>
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<td>Analyze Qualtrics</td>
<td>Responsible</td>
<td>Advise</td>
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<td>Pay Staff for Training</td>
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<td>N/A</td>
<td>Will Approve</td>
<td>N/A</td>
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<td>Implement Pilot</td>
<td>Project Manager</td>
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<td>Advise</td>
<td>N/A</td>
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<tr>
<td>Call Patients to collect data</td>
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<td>N/A</td>
<td>N/A</td>
<td>Responsible</td>
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<tr>
<td>Call Patients for dietary consult</td>
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<td>N/A</td>
<td>N/A</td>
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Appendix I

Qualtrics Pre-Education and Training Survey

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Answer the following questions using the scale above.

1. I am familiar with the term, ”Continuous Glucose Monitoring”.
2. I have had at least one patient using CGM assigned to the desk I have been working on this year.
3. I feel confident providing care to patients using CGM.
4. For patients using CGM, I titrate insulin for the patient and route the report to the provider afterwards.
5. For patients using CGM, I collect blood glucose only then route the blood glucose report to the provider for a new insulin titration order.
6. I would participate if offered training on CGM.
7. If CGM training included blood glucose and CGM report interpretation, I would feel confident titrating insulin dosages for patients using CGM.
**Appendix J**

| Module 1 | • Review Medtronic Guardian CGM device and CareLink software  
|          | • Review Dexcom G6 CGM device and Clarity software  
|          |   o Terminology  
|          |   o Blood glucose report selection  
|          |   o Blood glucose report interpretation |
| Module 2 | • CGM documentation  
|          | • CGM Communication and Data Sharing |
| Module 3 | • New NP-developed insulin titration protocol  
|          |   o For patients using multiple daily injections |
| Module 4 | • Case study  
|          |   o Accurately identify pertinent information  
|          |   o Implementation of new insulin titration protocol |
Appendix K

Provider-developed Insulin Titration Protocol

The table below shows the recommended values for glucose targets.

<table>
<thead>
<tr>
<th></th>
<th>Plasma Glucose Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting</td>
<td>60-90 mg/dL</td>
</tr>
<tr>
<td>Preprandial</td>
<td>60-100 mg/dL</td>
</tr>
<tr>
<td>1-hour Postprandial from beginning of food intake</td>
<td>&lt;130 mg/dL</td>
</tr>
<tr>
<td>2 am – 3 am</td>
<td>&gt;60 mg/dL</td>
</tr>
</tbody>
</table>

If inadequate control is reflected by two or more elevated fasting (>95 mg/dL) in one week or two or more elevated 1-hour postprandial glucose (>140 mg/dL) in one week, despite dietary and exercise compliance, the following medication guidelines will apply.

Assessment

A. Understanding all adherence to diet, exercise recommendations.

B. Ongoing knowledge and understanding of pregnancy process complicated by diabetes during pregnancy.

C. Adherence with insulin regimen.

D. Review of any signs or symptoms of hypo- and hyperglycemia.

Planning

A. Log onto CGM device platform.

B. Review CGM trending and Time in Range reports with patients using CGM technology during pregnancy.

C. CGM reports will be documented in the patient’s chart and routed to the provider for review.
**Intervention and Evaluation**

A. Severely elevated fasting blood glucose: CGM report evaluation of fasting blood glucose is >110 mg/dL for 2 days, patient will notify the registered nurse. The registered nurse will evaluate for obvious etiology. If elevation for 2 or more, refer to medication management.

B. Moderately elevated fasting blood glucose: CGM report evaluation of fasting blood glucose is 95-110 mg/dL for 2 days, registered nurse will verify adherence to diet and exercise recommendations. If patient has been adhering to diet and exercise recommendations, refer to provider for further evaluation or follow medical management. If patient has not been adhering to diet and exercise recommendations, nurse will discuss methods to improve adherence and develop a plan agreed upon by the patient.

C. Elevated postprandial glucose: if CGM report evaluation of 1-hour postprandial is >180 the registered nurse will verify adherence to diet and exercise recommendations. If patient has been adhering to diet and exercise recommendations, refer to provider for further evaluation or follow medication management. If patient has not been adhering to diet and exercise recommendations, the registered nurse will discuss methods to improve adherence and develop a plan agreed upon by the patient.

**Medication Management**

A. Adjust insulin dosages based on the following guidelines unless patient can attribute abnormal CGM reported values to dietary changes or illness.

B. For patients with long-acting insulin such as Lantus, refer to primary provider for dosage adjustment.
C. Based on the current protocol, registered nurses can increase rapid acting, short or intermediate insulin to a maximum of 18 units. If a higher dose is necessary, the primary obstetrical or maternal fetal medicine provider must be consulted.

D. Total insulin dose change should not exceed 20% of the previous insulin dose, unless orders for a greater percent change has been obtained and documented in the patient’s chart. Any increase should be rounded up to the next even increment.

E. Prior to an insulin increase of 20%, verify any previous history of nocturnal hypoglycemia. If patient has a history of hypoglycemia or nocturnal hypoglycemia, increase insulin to a maximum of 10% or consult with the primary obstetrical or maternal fetal medicine provider.

F. Post insulin increase of 20%, the registered nurse will instruct the patient to conduct a safety check at 3 am or endure CGM hypoglycemia alarms are set appropriately.

Note: Adapted from “Patient Care Guidelines: Home Management Insulin Requiring Diabetes Policy” by Regional Perinatal Service Center, 2019.
Appendix L
CGM Modules 1-4

CGM During Pregnancy
Module 1 CGM Basics

CGM During Pregnancy
Module 2 Professional Documentation and Data Sharing
Appendix M

Continuous Glucose Monitoring During Pregnancy: Post-Education and Training Survey

Start of Block: Default Question Block

Q1 Since completing the Continuous Glucose Monitoring and Diabetes Management During Pregnancy education and training modules, I feel competent with professional documentation in the EHR.

_____ Not at all (1)
_____ Somewhat (2)
_____ Completely competent (3)

Q2 I have cared for patients using Continuous Glucose Monitoring and Diabetes Management During Pregnancy before the CGM education and training modules.

☐ Not at all (1)
☐ Almost never (2)
☐ Some of the time (3)
☐ Most of the time (4)
☐ All of the time (5)

Q3 Since completing the CGM education and training modules, my knowledge of Continuous Glucose Monitoring and Diabetes Management During Pregnancy has increased.

☐ Not at all (1)
☐ A minor amount (2)
☐ A moderate amount (3)
☐ A significant amount (4)
Q4 The CGM module education level was appropriate for my learning.

- Not at all (1)
- Somewhat (2)
- I Completely agree (3)

Q5 The CGM module education utilized graphics and provided transcripts that enhanced my learning.

- Not at all (1)
- Somewhat (2)
- A moderate amount (3)
- I completely agree (4)

Q6 After completing the CGM modules, I feel competent providing care for patients using multiple daily injections and CGM as adjunctive therapy.

- Extremely competent (1)
- Moderately competent (2)
- Slightly competent (3)
- Neither competent nor incompetent (4)
- Slightly incompetent (5)
- Moderately incompetent (6)
- Extremely incompetent (7)
Q7 After completing the CGM education and training modules, I have a clear understanding of the NP-Developed CGM Insulin Titration Protocol.

- Not at all (1)
- Some understanding (2)
- Complete understanding (3)

Q8 After completing the CGM education and training modules, I feel competent providing care to users of CGM technology and using the NP-Developed CGM Insulin Titration Protocol.

- Extremely competent (1)
- Moderately competent (2)
- Slightly competent (3)
- Neither competent nor incompetent (4)
- Slightly incompetent (5)
- Moderately incompetent (6)
- Extremely incompetent (7)
Q9 After completing the CGM education and training modules, I feel confident answering my patient’s questions of CGM technology and use during pregnancy.

- Extremely confident (1)
- Moderately confident (2)
- Slightly confident (3)
- Neither competent nor incompetent (4)
- Slightly incompetent (5)
- Moderately incompetent (6)
- Extremely incompetent (7)

Q10 After completing the CGM education and training modules, I will seek CGM Certification to further enhance my learning.

- Not at all likely (1)
- Somewhat likely (2)
- Moderately likely (3)
- Highly likely (4)
- Definitely (5)

End of Block: Default Question Block

Table 1

**Provider-developed Insulin Titration Protocol**

<table>
<thead>
<tr>
<th>Plasma</th>
<th><strong>BMI &lt; 29</strong></th>
<th><strong>BMI &gt;/= 29</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fasting/Pre-breakfast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean BG</td>
<td>&lt; 60</td>
<td>Decrease evening or HS NPH by 20% or a minimum of 2 units</td>
</tr>
<tr>
<td>Mean BG</td>
<td>60-95</td>
<td>No change in NPH</td>
</tr>
<tr>
<td>Mean BG</td>
<td>96-110</td>
<td>Increase evening or HS NPH by 10%</td>
</tr>
<tr>
<td>Mean BG</td>
<td>&gt;110</td>
<td>Increase evening of HS NPH by 20%</td>
</tr>
<tr>
<td><strong>1 hour after breakfast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean BG</td>
<td>&lt;130</td>
<td>No change</td>
</tr>
<tr>
<td>Mean BG</td>
<td>130-160</td>
<td>Increase pre-breakfast Regular by 10% or increase Rapid-acting insulin at breakfast by 10%</td>
</tr>
<tr>
<td>Mean BG</td>
<td>&gt;160</td>
<td>Increase pre-breakfast Regular by 20% or increase Rapid-acting insulin at breakfast by 20%</td>
</tr>
<tr>
<td><strong>1 hour after lunch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean BG</td>
<td>&lt;130</td>
<td>No Change</td>
</tr>
<tr>
<td>Mean BG</td>
<td>130-160</td>
<td>Increase pre-breakfast NPH by 10% or Increase pre-lunch Regular by 10% or increase Rapid-acting insulin at lunch by 10%</td>
</tr>
<tr>
<td>Mean BG</td>
<td>&gt;160</td>
<td>Increase pre-breakfast NPH by 20% or Increase pre-lunch Regular by 20% or increase Rapid-acting insulin at lunch by 20%</td>
</tr>
<tr>
<td>Pre-Dinner</td>
<td>Mean BG</td>
<td>Action 1</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>&lt;60</td>
<td>Decrease Pre-breakfast NPH by 20% or a minimum of 2 units or add CHO exchange to afternoon snack</td>
<td>Decrease Pre-breakfast NPH by 20% or a minimum of 2 units or add CHO exchange to afternoon snack</td>
</tr>
<tr>
<td>60-110</td>
<td>No change in NPH</td>
<td>No change in NPH</td>
</tr>
<tr>
<td>111-130</td>
<td>Increase pre-breakfast NPH by 10% or Increase Pre-dinner Regular insulin by 10% or Increase Rapid-acting insulin at dinner by 10%</td>
<td>Increase pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
</tr>
<tr>
<td>&gt;130</td>
<td>Increase pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
<td>Increase pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 hour after dinner</th>
<th>Mean BG</th>
<th>Action 1</th>
<th>Action 2</th>
<th>Action 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;130</td>
<td>No change</td>
<td>No change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130-160</td>
<td>Increase Pre-breakfast NPH by 10% or Increase Pre-dinner Regular insulin by 10% or Increase Rapid-acting insulin at dinner by 10%</td>
<td>Increase Pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;160</td>
<td>Increase Pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
<td>Increase Pre-breakfast NPH by 20% or Increase Pre-dinner Regular insulin by 20% or Increase Rapid-acting insulin at dinner by 20%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Adapted from “Patient Care Guidelines: Home Management Insulin Requiring Diabetes Policy” by Regional Perinatal Service Center, 2019.
Table 2
ADA Recommended Pregnancy Guidelines by Diabetes Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gestational Diabetes (GDM)</th>
<th>Type 2 Diabetes (DM2)</th>
<th>Type 1 Diabetes (DM1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Glucose Goals</td>
<td>Fasting: &lt;95 mg/dL</td>
<td>Fasting: &lt;95 mg/dL</td>
<td>Fasting: &lt;95 mg/dL</td>
</tr>
<tr>
<td></td>
<td>One-hour postprandial glucose: &lt;140 mg/dL</td>
<td>One-hour postprandial glucose: &lt;140 mg/dL</td>
<td>One-hour postprandial glucose: &lt;140 mg/dL</td>
</tr>
<tr>
<td></td>
<td>Two-hour postprandial glucose: &lt;120 mg/dL</td>
<td>Two-hour postprandial glucose: &lt;120 mg/dL</td>
<td>Two-hour postprandial glucose: &lt;120 mg/dL</td>
</tr>
<tr>
<td>Medical Nutritional Therapy (DRI)</td>
<td>175 g carbohydrate, 71 g protein, 28 g fiber</td>
<td>175 g carbohydrate, 71 g protein, 28 g fiber</td>
<td>175 g carbohydrate, 71 g protein, 28 g fiber</td>
</tr>
<tr>
<td>Pharmacologic Therapy</td>
<td>Oral antihyperglycemic; Insulin is first line treatment</td>
<td>Metformin until 12 weeks GA, then glyburide or insulin</td>
<td>Insulin by multiple daily injections or insulin pump therapy</td>
</tr>
<tr>
<td>Education</td>
<td>Lifestyle management, glucometer use</td>
<td>Lifestyle management, glucometer use, pharmacologic therapy, prevention of hypoglycemia</td>
<td>Lifestyle management, glucometer and insulin pump use, continuous glucose monitor use, prevention of hypoglycemia</td>
</tr>
<tr>
<td>Risk of Pregnancy Loss</td>
<td>Comparable to that of normal pregnancy</td>
<td>Highest in third trimester</td>
<td>Highest in first trimester</td>
</tr>
<tr>
<td>HbA1c</td>
<td>&lt;6%</td>
<td>&lt;6% or &lt;7% to prevent hypoglycemia</td>
<td>&lt;6% or &lt;7% to prevent hypoglycemia</td>
</tr>
</tbody>
</table>

Table 3

CGM Device Comparison

<table>
<thead>
<tr>
<th><strong>Dexcom G6</strong>*</th>
<th><strong>Medtronic Guardian</strong>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatible with smart device or receiver</td>
<td>Guardian Connect App</td>
</tr>
<tr>
<td>Clarity Report Software</td>
<td>CareLink Software</td>
</tr>
<tr>
<td>Smartphone App personalizes glucose thresholds</td>
<td>Customize notifications</td>
</tr>
<tr>
<td>Provide real-time glucose every 5 minutes</td>
<td>Provide real-time glucose every 5 minutes</td>
</tr>
<tr>
<td>Records up to 288 readings in 24-hour period</td>
<td>60 minute advance prediction of highs or lows</td>
</tr>
<tr>
<td>Reduces A1c level by up to 1.3% in Type 1 DM</td>
<td>Visibility of time spent high</td>
</tr>
<tr>
<td>Decreases time in spent in hypoglycemia</td>
<td>Sugar.iQ App compatible</td>
</tr>
<tr>
<td>Alarms approaching low levels</td>
<td>Text notifications to five loved ones with alerts</td>
</tr>
<tr>
<td>Doesn't require fingersticks or calibrations</td>
<td>Requires calibration at least every 12 hours</td>
</tr>
</tbody>
</table>

*www.dexcom.com

Figure 1

CGM Software Comparison

Dexcom Clarity

Note: A sample of the Dexcom Clarity Diabetes Management Software showing blood glucose ranges over a 2-day period. Adapted from 2020 Dexcom Clarity Diabetes Management Software Products, by Dexcom, 2020 https://www.dexcom.com/clarity.
Figure 2
CGM Software Comparison
Medtronic CareLink

Note: A sample of the Medtronic Carelink Personal software showing blood glucose data from a continuous glucose monitor and glucometer over a 2-week period. Adapted from 2020 Carelink Personal Diabetes Software Products, by Medtronic, 2020
Note: Lewin’s Theory of Change. Unfreezing: Initial needs assessment identified gap in nursing education on CGM technology and delay in care for patients who use CGM during pregnancy. Change in Practice: Education modules provided to registered nurses on CGM technology and the NP-developed protocol for titrating insulin. Refreezing: Positive response from CGM education modules equipped registered nurses’ utilization of the NP-developed protocol to guide clinical decision-making, no longer delaying care waiting for a new insulin order from the provider.
Figure 4

CGM Post-Education Survey Data

Post-Education and Training Survey
Was the CGM education level appropriate for learning?

66.67% of respondents completely agreed the CGM education level was appropriate for their learning, while 33.33% felt it was somewhat appropriate for their learning.
Note: CGM During Pregnancy and Diabetes Management Post-Education Survey, 2020. Since completing the CGM education and training modules, 33% or respondents reported an increase in knowledge of CGM and diabetes management a significant amount, a moderate amount, and a minor amount.
Figure 6

Hemoglobin A1c Comparison

*Note:* The Hemoglobin A1c chart shows patients with their starting HgbA1c in blue and the final HgbA1c in orange. All but one patient showed a decrease in HgbA1c at the end of the pilot or at delivery.