AN EVIDENCE-BASED PROTOCOL FOR THE ASSESSMENT AND MANAGEMENT OF GLUCOCORTICOID-INDUCED HYPERGLYCEMIA

A DOCTOR OF NURSING PRACTICE PROJECT SUBMITTED TO THE OFFICE OF GRADUATE EDUCATION OF THE UNIVERSITY OF HAWAIʻI AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF NURSING PRACTICE

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Dedication

I would like to dedicate this work to my family, who have instilled in me the values of hard work and perseverance and have whole-heartedly supported my educational journey. I also would like to dedicate this work to my love, Davin, who has rooted for me throughout the struggles and achievements of this doctoral program.

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Abstract

Glucocorticoid-induced hyperglycemia (GCIH) has been associated with negative patient outcomes. Oncology inpatients are particularly affected by GCIH, as they are prescribed high-dose glucocorticoids (GC) during their hospitalization. Yet, organizational data highlights variability in treatment, suboptimal glycemic control, and a gap in the timeliness of therapy. The purpose of this Doctor of Nursing Practice (DNP) project was to improve GCIH assessment and management for oncology inpatients receiving GCs. The Iowa model was used as the guiding framework for translating evidence into clinical decision-making for this project.

An evidence-based protocol that included a Best Practice Advisory (BPA) within the electronic medical record and a standardized algorithm was developed and implemented. The goal was to immediately initiate blood glucose monitoring (BGM) and sliding scale insulin (SSI) therapy in concurrence with a GC order to promptly detect and treat GCIH, thereby reducing uncontrolled hyperglycemia rates. Average length of stay (ALOS) days were also evaluated to assess for any correlations with Diabetes Team consults and uncontrolled hyperglycemia rates.

The sample group within a four-month period comprised of 49 patients with hematologic malignancies who were prescribed GCs. The results revealed an improvement in BGM orders, Diabetes Team consults that met criteria, total uncontrolled hyperglycemia episodes, and hypoglycemic events. There was a decrease in SSI orders and an overall increase in ALOS by six days. A trend in more prolonged hospitalizations was noted in patients with uncontrolled hyperglycemia.

The data was not strong enough to produce conclusions for both process and impact evaluations. It is possible that a Hawthorne effect occurred as a result of a recurrent discussion

of this project at multiple meetings. It is challenging to infer a direct correlation of ALOS with Diabetes Team consults due to many potential influential factors.

Improvement in GCIH detection and management resulted in a reduction of uncontrolled hyperglycemic episodes. Further benefits associated with GCIH management need to be explored with larger samples.

Limitations included sample size and time, patient right to refusal of care, staffing considerations, variance in clinical judgment and preferences for administrative autonomy, and factors impacting ALOS and hyperglycemia.

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CHAPTER 1. EXECUTIVE SUMMARY

Introduction

Background/Problem

Glucocorticoid-induced hyperglycemia **(**GCIH) has been associated with negative outcomes and treatment-related morbidities. Oncology inpatients are among the most affected populations of GCIH, as they are often prescribed high-dose glucocorticoids (GC). Rates of blood glucose monitoring (BGM) and appropriate management for GCIH remain low or inconsistent. The purpose of this Doctor of Nursing Practice (DNP) project was to improve GCIH assessment and management to reduce the rates of uncontrolled hyperglycemia (>180 mg/dl) experienced by the inpatient population with hematological malignancies receiving GCs.

Conceptual Framework

The Iowa model by Titler et al. (2001) is a seven-step guide for translating evidence into practice and clinical decision-making. The seven steps are: 1) Select a topic based on problem and knowledge-focused triggers, 2) Form a team, 3) Assemble critique and synthesize the literature, 5) Develop practice change, 6) Implement the change, and 7) Evaluate the change.

Literature Review and Synthesis

Mosby's Quality of Evidence (Melnyk, 2004) and the Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument (Brouwers et al., 2013) were used to grade the evidence of 21 synthesized articles. The themes from the literature that were specifically recognized for this DNP project include: 1) GCIH prevalence, 2) Definition of hyperglycemia, 3) Effects of hyperglycemia on patient outcomes, 4) BGM protocols for GCIH, and 5) Treatment for GCIH.

Innovation/Objectives

The most appropriate strategy to address GCIH was the implementation of an evidence-based (EB) protocol to standardize the assessment and management of GCIH. The goal was to immediately initiate BGM and sliding scale insulin (SSI) therapy in concurrence with a GC order, thereby aiding in the prompt detection and treatment of GCIH. It was expected that the prolongation of untreated hyperglycemia would be reduced, which subsequently had the potential to decrease uncontrolled hyperglycemia rates and improve clinical patient outcomes such as average length of stay (ALOS).

Methods

Practice Change Description

The current process involves inconsistent practice in ordering BGM, insulin, and Diabetes Team consults for patients that had GC orders. This inconsistency would be addressed through the implementation of an electronic Best Practice Advisory (BPA) within the patient's medical record that notified providers and nurses to place the orders for BGM and insulin as soon as GC therapy was initiated. The protocol additionally provided guidance in GCIH management through an algorithm that notes when to escalate care to the Diabetes Team, based on established BG level readings.

Setting and Sample

The project was implemented on two inpatient oncology units within a large tertiary care hospital in Hawai'i. The sample population criteria consisted of adult inpatients with hematologic malignancies receiving GCs, who were admitted or transferred to and discharged from either of the two oncology units.

Data Collection

The data elements of the impact evaluation were uncontrolled hyperglycemia rates and ALOS days; as for the process evaluation, the data elements were the number of BGM orders, insulin orders, and Diabetes Team consults. Data collection incorporated running data sets based on the established codes that reflect the specified population in regards to the desired variables over a designated four-month time frame.

Results

Description of Participants

The baseline group consisted of 75 patients who met criteria between April 1, 2017 and July 31, 2017. The post-implementation group was comprised of 49 patients who met criteria between September 1, 2017 and December 31, 2017.

Data Analyses Findings

The process evaluation revealed a 3% increase in BGM orders, an 8% increase in Diabetes Team consults, and a 7% decrease in insulin orders. An improvement in Diabetes Team consults that appropriately met criteria was supported by a 54% increase in the number of uncontrolled hyperglycemia episodes with a Diabetes Team consult. The impact evaluation presented a 3% decrease in total uncontrolled hyperglycemia episodes and an overall ALOS increase by six days in both groups with and without a Diabetes Team consult. A trend of prolonged hospitalization was also noted in the patients with uncontrolled hyperglycemia in comparison to the patients with controlled glycemic levels.

Discussion

Interpretation of Results

Overall, with the resulting sample size of 49, trends can be noted, however, the data is not strong enough to produce conclusions for both process and impact evaluations. It is possible that a Hawthorne effect occurred as a result of attendance and discussion of the project at multiple oncology committee meetings and oncology staff meetings throughout 2017. The decreasing trend in insulin orders could be attributable to the provider's concern for hypoglycemia, a frequent concern discussed in meetings. The low number of consults could infer that patients are not reaching the >180 mg/dl BG level, the advised criteria for consults. The decrease in total oncology unit patients with BG levels greater than 180 mg/dl could indicate the positive impact of the GCIH protocol. It is challenging to conclude a direct correlation between the presence of a Diabetes Team consult or lack thereof with ALOS.

Implications

EB standards of care, clinical judgment, and collaborative professional relationships were utilized to produce and implement a standardized GCIH protocol. This protocol was essential to increase awareness of GCIH and empower staff to proactively assess and manage GCIH. Improvement in GCIH detection and management resulted in a reduction in the rates of uncontrolled hyperglycemic episodes. Further benefits associated with GCIH management needs to be explored.

Limitations

Despite efforts to account for risks, there are factors in addition to the proposed protocol that may influence outcomes. These limitations included sample size and time, patient right to refusal of care, staffing considerations, variance in clinical judgment and preferences for

administrative autonomy, and factors impacting ALOS. Within the setting of a quality improvement initiative, it is not realistic that all conditions can be controlled.

CHAPTER 2. PROBLEM

Introduction

Hyperglycemia is a common complication of GC therapy, regardless of a patient's previous history of diabetes mellitus (DM). Oncology inpatients are frequently treated with GCs in concurrence with their cancer treatment. GCIH has been associated with negative outcomes and treatment-related morbidities. Despite this knowledge, rates of BGM and appropriate management for GCIH remain low or inconsistent. The purpose of this DNP project was to improve GCIH detection and management and reduce the rates of uncontrolled hyperglycemic episodes experienced by the inpatient oncologic population receiving GCs. This chapter will review the background of GCIH; describe the literature search, critique and synthesis; and conclude with a recommended EB protocol.

Background/Problem

The American Association of Clinical Endocrinologists and American Diabetes Association define hospital-related hyperglycemia as a BG reading greater than 140 mg/dl, at any given time during hospitalization (The American Diabetes Association, 2015; Magaji & Johnston, 2011). Hyperglycemia is prevalent in 38% to 46% of non-critically ill inpatients and in approximately 80% of critically ill and cardiac surgery patients (Corsino, Dhatariya, & Umpierrez, 2014; Gomez & Umpierrez, 2014). There is a vast body of evidence that supports the fact that hyperglycemia, independent of a patient's history of DM, is associated with poor clinical patient outcomes. A few days of hyperglycemia - also referred to as transient hyperglycemia - can be linked to increased risks of mortality and incidences of infection, deleterious effects on the immune system, prolonged hospital stays, higher admission rates to the intensive care unit, and increased disability after discharge that warrants a greater need for

transitional or nursing home care (Corsino et al., 2014; Umpierrez et al., 2012). Interestingly, increasing evidence indicates that new-onset hyperglycemia in hospitalized patients without a preexisting diabetic history has led to greater complications and in-hospital mortality rates than in those with a prior history of DM (Buehler et al., 2015; Corsino et al., 2014; Koskela, Salonen, Romppanen, & Niskanen, 2014).

Medications that induce hyperglycemia, such as GCs, are one of the main etiologies of elevated BG levels in the inpatient setting (Corsino et al., 2014; Seheult et al., 2014; Tamez-Pérez, Quintanilla-Flores, Rodriguez-Gutierrez, Gonzalez-Gonzalez, & Tamez-Pena, 2015). GCs have profound effects on glucose metabolism, causing a decrease in both insulin secretion and insulin sensitivity (Gonzales-Gonzalez et al., 2013). Although it is to be expected that BG levels in a non-diabetic patient would return to euglycemic levels subsequent to the withdrawal of the hyperglycemia-provoking agent, this is not always the case with GCs. GC therapy can exacerbate hyperglycemia in patients with known DM. In addition, GCs can elevate BG readings to nearly 68% higher than baseline levels, permanently induce hyperglycemia, and cause DM in over 50% of patients without a prior history of DM or hyperglycemia (Gonzalez-Gonzalez et al., 2013; Tamez-Pérez et al., 2015; Perez et al., 2014).

Regardless of the GC-related risks, more than 12% of hospitalized patients in the nation are prescribed high-dose GCs; however, rates of BGM and appropriate management continue to be very low (Dhatariya, 2014). For example, a prevalence study conducted over two consecutive days by Narwani, Swafe, Stavraka, and Dhatariya (2014) found that of 120 patients being treated with GCs, only 25 patients were receiving routine BGM during their hospital stay.

Cancer patients are among the most affected populations of GCIH, as they are often prescribed high-dose GCs during their hospitalization for a number of therapeutic reasons: as a

component of their chemotherapy, as an appetite stimulator, and for the management of nausea and vomiting, control of tumor-associated pain, and reduction of cerebral edema (Brady, Grimes, Armstrong, & LoBiondo-Wood, 2014; Dietrich, Rao, Pastorino, & Kesari, 2011). Unfortunately, along with these benefits come not only the aforementioned effects of hyperglycemia, but also negative impacts on diagnostic imaging studies, the development and progression of cancers, and alterations of treatment responses (Storey & Von Ah, 2015).

GC therapy may be administered in different doses through a variety of routes, but it is most often administered as a single daily morning regimen. Within four to eight hours of the administration of an oral dose - and sooner with intravenous routes - this morning regimen causes predictable rises in BG levels, leading to postprandial elevations in glycemic levels in the late morning through the afternoon (Brady et al., 2014; Corsino et al., 2014). Overnight, BG levels typically stabilize, returning to baseline levels by the next morning (Corsino et al., 2014). As a result, elevated levels are not always reflected in the patient's fasting BG levels in the morning, either through BGM or a basic metabolic panel blood test. This means that there is potential for GCIH to go unnoticed in patients without a pre-existing DM diagnosis, as well as patients who may not have orders for scheduled BGM throughout the day. Further, GCIH may also be overlooked as a treatment priority, as the medical treatment plan will naturally be targeted at the patient's presenting symptoms or admission diagnoses.

The physicians at the outpatient Cancer Center initially raised the issue of GCIH after noting an increasing trend in hyperglycemia in their oncology patients who were receiving GCs as part of their chemotherapy regimen. In March 2016, the Cancer Center contacted the inpatient Diabetes Team, as well as a partnering Cancer Center in Texas, to inquire about management guidelines specific to GCIH. It was then realized that there was no such protocol in place in the

inpatient and outpatient settings within the organization for the assessment and management of GCIH. EB guidelines established by the Endocrine Society advise BGM for at least 24-48 hours for patients who are prescribed GCs (Umpierrez et al., 2012). In addition, the initiation of hyperglycemia management should be conducted as necessary for consistent BG levels >140 mg/dl (Umpierrez et al., 2012). Furthermore, the Joint Commission Advanced Disease-Specific Care for Inpatient Diabetes Care requires BGM protocols and individualized plans for hyperglycemia treatment (Isbey, Gomez, & Mooney, 2013).

In response to the inquiry by the Cancer Center physicians, the designated data analyst for the Diabetes Team collected retrospective data between 7/1/2015 and 3/31/2016. The data were related to information regarding inpatients in the oncology units with an ICD-10 diagnosis description containing "neoplasm" and with BG levels ≥200 mg/dl, with and without a Diabetes Team consult, as seen in Table 1 below. The results revealed that over 50% of the 405 total patients that met sample criteria experienced BG readings reaching levels that were ≥300 mg/dl. In addition, there was a notable difference between the number of patients experiencing hyperglycemia without a Diabetes Team consult as compared to those who had one.

Table 1

BG Levels in Relation to Diabetes Team Consults on the Oncology Units

Consult	BG 200-299	BG 300-399	BG ≥ 400	Grand Total
Yes	7	7	2	16
No	194	151	44	289
Total	201	158	46	405

Another set of retrospective data was collected using information about patients who were admitted or transferred to the oncology units and were discharged between 1/1/2016 and 8/31/2016. These patients were also assigned an ICD-10 diagnosis containing “neoplasm” and medication orders for GCs, as seen in Table 2 below. Variables collected included whether these

patients had orders for BGM, insulin therapy, and a Diabetes Team consult. Of the 527 patients meeting the above criteria, 53% of the patients did not have orders for BGM, 70% did not have insulin orders, and 96% did not have a Diabetes Team consult. Only 4% of the patients had the triple combination of orders for glucose checks, insulin therapy, and a Diabetes Team consult.

Table 2

BGM Orders, Insulin Orders, and Diabetes Team Consults on the Oncology Units

Response	BGM Orders	Insulin Orders	Diabetes Team Consults
Yes	249	158	23
No	278	369	504
Totals	527	527	527

The data results from both Table 1 and Table 2 reflect variability in care delivery, suboptimal monitoring and glycemic control, a gap in the timeliness of management, as well as the under-utilization of a valuable resource - the Diabetes Team. Delays in treatment remain one of the top ten sentinel events in the nation, as recorded by The Joint Commission (TJC) (2016).

Conceptual Framework

The Iowa model by Titler et al. (2001) is a seven-step guide for translating evidence into practice. The model places an emphasis on the importance of considering not only literature research but also other types of evidence in clinical decision-making (e.g., expert opinions, case reports, scientific principles, and theories), as seen in Appendix A. The first step involves the identification of problem- or knowledge-focused triggers. These triggers act as a catalyst for registered nurses (RNs) to evaluate current practices and question whether patient care could be enhanced based on empirical evidence (Hall & Roussel, 2014). A unique feature of the Iowa model is that the issue of focus must be deemed a priority for the organization based on key factors such as the magnitude of the problem, its fit with the strategic goals of the organization, the number of people interested in the topic, the level of interdisciplinary support, cost

implications, and the potential barriers to change (Titler et al., 2001). This is a pivotal piece in making successful progress to the second step of recruiting support and, in turn, formulating an interdisciplinary team likely comprised of all interested stakeholders (Doody & Doody, 2011).

The third and fourth steps involve the retrieval, careful critique, and synthesis of relevant literature that support the change in clinical practice. It is critical to determine whether or not sufficient data exists to validate the quality to guide the practice change. Titler et al. (2001) recommended a group approach in order to: 1) Distribute the workload, 2) Increase understanding of the change, 3) Place accountability on all members, and 4) Create a learning environment for novices to gain practice with literature critique and application into practice. Incorporating other types of evidence or conducting a research study are two strategies to supplement the literature that has been collected to help the team develop the patient-centered EB practice change (Doody & Doody, 2011; Titler et al., 2001).

The fifth step details the development of the practice change, with careful consideration of the implementation process to gauge its level of feasibility and effectiveness. This stage of practice change development involves guideline establishment based on findings from the synthesized evidence, designation of the intervention outcomes, baseline data collection, and creation of an evaluation plan (Titler et al., 2001). This stage lays the foundation for the sixth step of implementing the practice change.

Once the practice change has been implemented, the seventh and final step encompasses the monitoring and analyzing of the structure, process, and outcome data. This final evaluation stage is important to provide insight into the impact that the change in practice has made to patient care through comparison of baseline and post-implementation data (Titler et al., 2001).

Literature Critique and Synthesis

An electronic search was completed using PubMed and CINAHL databases. Search terms included *glucocorticoids, steroids, hyperglycemia, cancer, oncology, inpatient, hospitalized, treatment, management, protocol, and guideline*, which yielded a total of 104 articles. For the purpose of this review, twenty-one articles have been synthesized on the basis of exclusion criteria that included pediatric populations, non-English language publications, and articles published over six years ago.

Mosby's Quality of Evidence (Melnyk, 2004) was used to grade the level of evidence as represented in Table 3, with an "Other" category that includes quality performance improvement and review of the literature.

The Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument was used for further evaluation of the two clinical practice guidelines (CPGs) included in the Level VII evidence, as seen in Table 4 below. The AGREE II instrument consists of 23 key items organized within six domains followed by an overall quality assessment score of the guideline. The six different domains were designed to assess the methodological rigor and transparency in which the CPG was developed (Brouwers et al., 2013). The domains include: 1) Scope and purpose, 2) Stakeholder involvement, 3) Rigor of development, 4) Clarity of presentation, 5) Applicability, and 6) Editorial independence. Each domain includes a set of items that are rated on a 7-point scale (1– strongly disagree to 7–strongly agree) and subsequently calculated for a domain score. The overall quality assessment score is also rated on a 7-point scale (1– lowest possible quality to 7–highest possible quality).

Table 3

Number of Synthesized Articles According to Mosby's Level of Evidence

Level of evidence	Description	Number of articles
I	Meta-analysis	0
II	Experimental design/randomized control trial	1
III	Quasi-experimental design	0
IV	Case-controlled, cohort studies, longitudinal studies	10
V	Correlation studies	0
VI	Descriptive studies including surveys, cross-sectional design, developmental design, and qualitative studies	3
VII	Authority opinion or expert committee reports	2
Other	Performance improvement, review of literature	5

Note. Descriptions of level of evidence adapted from the Mosby's Quality of Evidence featured in "Integrating levels of evidence into clinical decision making," by B.M. Melnyk, 2004, *Pediatric Nursing*, *30* (4), 323-325.

Table 4:

Clinical Practice Guideline AGREE II Scores

Reference	Domain score	Overall quality assessment score
Roberts, James, & Dhatariya, 2014	86%	6
Umpierrez et al., 2012	91%	6

Note. The AGREE II Tool can be found at http://www.agreetrust.org

All of the reviewed articles feature the topic of hyperglycemia or GCIH, with the majority of the articles concentrating on the hospitalized adult oncology population receiving GCs concurrently with chemotherapy. The themes from the literature that were specifically recognized for this DNP project include: 1) GCIH prevalence, 2) Definition of hyperglycemia, 3) Effects of hyperglycemia on patient outcomes, 4) BGM protocols for GCIH, and 5) Treatment for GCIH.

Prevalence of GCIH

The prevalence rate of GCIH varied among the literature, ranging from 22.1% to 86%. Although it is expected that sample sizes and duration of BGM will differ among studies, the specificity of the inclusion and exclusion characteristics of the sample population appeared to have the most notable impact on the prevalence rate, particularly to patients without a prior history of DM. Certain studies excluded patients with pre-existing DM, as well as those with a history of previously elevated BG (Fong & Cheung, 2013; Jeong et al., 2016; Pilkey, Streeter, Beel, Hiebert, & Li, 2012). Other studies excluded patients who were already on medications that caused secondary hyperglycemia (Fong & Cheung, 2013; Gonzalez-Gonzalez et al., 2013). These criteria were enforced in an attempt to control for potential external factors that could concurrently contribute to the hyperglycemia and help to specifically evaluate the effects of GCs on glycemic levels.

With regards to the literature that did not enforce the exclusion criteria, it is difficult to ascertain whether the patients from the associated study were truly experiencing GCIH. For instance, in the prospective cohort study by Harris et al. (2013, Level IV), hyperglycemia was detected in a total of 58.9% of the sample, which included both non-DM and DM patients. In contrast, a correlation pilot study that evaluated hyperglycemia specifically in non-DM chemotherapy-treated cancer patients receiving antiemetic dexamethasone therapy, showed a GCIH prevalence rate of 22.1% (Jeong et al., 2016, Level IV). Interestingly, in a prospective case-controlled study, which controlled for a non-DM sample, 86% of patients who were administered high-dose steroids experienced at least one episode of hyperglycemia (Fong & Cheung, 2013, Level IV). Nonetheless, despite varying sample populations, the literature confirms the prevalence of GCIH in patients both with and without a history of DM.

Definition of Hyperglycemia

Hyperglycemia was most frequently deemed as fasting levels or pre-prandial BG levels >140-144 mg/dl, or a random or two-hour postprandial BG level >180 mg/dl (Brady et al., 2014, Level Other; Fong & Cheung, 2013, Level IV; Gerards, Tervaert, Hoekstra, Vriesendorp, & Gerdes, 2015, Level VI; Harris et al., 2015, Level IV; Jung et al., 2014, Level IV; Lansang & Hustak, 2011, Level VII; Perez et al., 2014, Level Other; Roberts, James, & Dhatariya, 2014, Level VII; Seheult et al., 2015, Level VII). The American Diabetes Association and the Endocrine Society both define inpatient hyperglycemia as any BG value ≥140 mg/dl (Umpierrez et al., 2012, Level VII). Therefore, the variance in hyperglycemia definitions among the literature could be attributed to the differing characteristics of the sample populations.

More stringent definitions of hyperglycemia included fasting BG levels >100-110 mg/dl. It is probable that the use of this hyperglycemia definition in the Level IV study by Gonzalez-Gonzalez et al. (2013) was due to the acuity level of the sample population, which involved non-critically ill adult patients receiving GCs who likely did not have a history of DM or hyperglycemia at baseline. The aim of the Level IV study by Fuji et al. (2009) focused on the benefits of intensive glucose control after allogeneic hematopoietic stem cell transplantation and thus, glycemic goals were of a lower threshold. In contrast, less stringent hyperglycemia definitions included BG levels >200-215 mg/dl. Examples of this definition classification were evident in the Level IV study by Pilkey et al. (2012), where the sample population involved palliative care patients who would not benefit from strict glycemic control. Overall, the presence of conflicting hyperglycemia definitions suggests the under-treatment of hyperglycemia in hospitalized patients nationwide.

Effects of Hyperglycemia on Clinical Patient Outcomes

It has been well established in the literature that hyperglycemia contributes to poor clinical patient outcomes. A literature review that included 124 articles from over the time span from 1976 to 2014 (Corsino et al., 2014, Level Other), along with a Grade 6 quality CPG (Umpierrez et al., 2012, Level VII), emphasizes that even transient hyperglycemia can be linked to increased risks of mortality and incidences of infection, deleterious effects on the immune system, prolonged hospital stays, higher admission rates to an intensive care unit, and increased disability after discharge that warrants greater needs for transitional or nursing home care.

A prospective observational cohort study by Koskela et al. (2014, Level IV) monitored the correlation between mortality and the occurrence of postprandial hyperglycemia in 153 consecutive hospitalized patients admitted for mild to moderate community-acquired pneumonia. At the end of the five-year follow-up, the patients in the sample population who were admitted without prior DM diagnosis, but who acquired postprandial hyperglycemia within the first 24 hours of their hospitalization, had a 37% mortality rate, as compared to patients without a DM diagnosis and without postprandial hyperglycemia.

Similarly, another retrospective cohort study by Buehler et al. (2015, Level IV) evaluated the effects of hyperglycemia in 2,451 patients, with and without a history of DM, who underwent gastrointestinal surgery. The differences in mean calculated costs of care in patients with no diabetic history and normoglycemia, no diabetic history and hyperglycemia, and diabetics, were illustrated, as seen in Table 5 below. The calculated costs in relation to Hawaii hospitals were retrieved (Kaiser Family Foundation, 2016; Rizzo, 2013) and included to better evaluate the differences.

It is interesting to note that even without a previous history of DM, hyperglycemia can be

costly, with greater risks of complications, length of stay, and overall hospitalization costs. In comparison to the patients with normoglycemia, the 64.3% of patients who experienced hyperglycemia had a higher number of complications, longer hospital stays, more readmissions within 30 days, and higher hospitalization costs.

Table 5

Comparison of Mean Calculated Hospital Costs Based on Glycemic Status

	A) No-DM, normoglycemic, N (per article)	B) No-DM, hyperglycemic, N (per article)	C) DM N (per article)	Calculated Hawaii cost
Complications:				
LOS days	5	9	9	$2,157 per day A = $10,785 B = $19,413 C = $19,413
Readmission in 30 days	49	193	85	$11,200 per case A=548,800 B=$2,161,600 C=952,000
Acute MI	1	22	10	$13,200 per case A = $13,200 B = $290.400 C = $132,000
Wound infection	19	129	53	$3,937 per case A = $74, 803 B = $507,873 C = $208,661
Pneumonia	8	108	50	$13,000 per case A = $104,000 B = $1,404,000 C = $650,000
Sepsis	1	5	3	$18,400 per case A = $18,400 B = $92,000 C = $55,200
Total hospitalization costs	$20,273	$72,675	$79,545	

Note: *Calculated Hawaii costs are from 2013-2016 sources and may differ from current costs.

In recent years, there has been limited literature that explains the correlation of hyperglycemia and adverse outcomes specifically among oncology patients; however, the available data is consistent in reinforcing the significance of managing hyperglycemia to reduce negative outcomes. A retrospective case-controlled study by Jung et al. (2014, Level IV) investigated the correlation between the incidence of hyperglycemia and the development of severe infection during the early period of initial chemotherapy in patients with newly diagnosed multiple myeloma. An analysis of 155 patient records between November 2002 and February 2013 revealed that the patients who developed severe infections were part of the overt hyperglycemia group, experiencing BG levels above 200 mg/dl (Jung et al., 2014, Level IV).

Similar results were noted in a retrospective cohort study by Fuji et al. (2009, Level IV) that involved recipients of allogeneic hematopoietic stem cell transplantation (HSCT) in patients with hematologic malignancies. The study first examined the benefits of intensive glucose control (IGC) by monitoring BG levels every morning and up to four times a day, with glycemic correction with insulin as needed. The study went on to evaluate the benefits of standard glucose control (SGC), which entailed no specific protocol aside from monitoring at least three times weekly to avoid severe hyperglycemia. The study found that the incidence of documented infections – particularly bacteremia - within 100 days of HSCT was significantly lower in the IGC group compared to the SGC group, with a positive correlation between infection and hyperglycemic rates (Fuji et al., 2009, Level IV).

Finally, a study by Weiser et al. (2004, Level IV) was conducted to determine the prevalence of hyperglycemia during induction chemotherapy for acute lymphocytic leukemia using a regimen comprised of dexamethasone and to determine the effect of hyperglycemia on survival, duration of disease remission, and treatment-related complications. Of the 278 patients

included in the study, 103 (37%) experienced GCIH with BG levels >200 during induction chemotherapy, and only 20 of those patients (7%) had a previous diagnosis of DM. Patients with hyperglycemia had a shorter median complete remission duration (24 months vs. 52 months) and a shorter median survival (29 months vs. 88 months) compared with patients without hyperglycemia. Those patients who experienced hyperglycemia were also more likely to develop sepsis (16.5% vs. 8%) compared with patients without hyperglycemia.

Although these studies demonstrate sufficient internal validity, there are threats to external validity, as the studies focused specifically on multiple myeloma, recipients of HSCT, and ALL. Additional prospective studies are needed to assess whether enhanced glycemic control can improve outcomes in a variety of oncology diagnoses. Overall, the importance of the need to control hyperglycemia, both promptly and adequately, continues to be emphasized.

BGM Protocols for GCIH

Despite the evidence, which emphasizes the significance of hyperglycemia on patient outcomes, the literature reveals that BGM is often overlooked in hospitalized patients, especially in patients without prior DM history. For example, a prevalence study by Narwani et al. (2014, Level VI) was conducted over two consecutive days on patients receiving GCs for various indications, with 10% of the patient cohort receiving GCs for oncologic reasons. Results showed that only 25 of the total 120 patients (20.8%) received routine BGM during their hospitalization. Patients with pre-existing DM were more likely to have BGM compared to those without DM.

This study by Narwani et al. (2014, Level VI) primarily focused on process prevalence, and thus, was met with the limitation of whether BG levels and patient outcomes were affected by the lack of monitoring. It is also difficult to discern whether the exact reason for the absence of monitoring was due to a lack of knowledge by providers to place BGM orders, failure of

BGM to be initiated by staff, or the lack of perceived need of BGM by providers based on the patients' characteristics. The inconsistency in BGM reveals a possible lapse in knowledge regarding the deleterious effects of GCIH and the significance of BGM.

A factorial survey by Gerards et al. (2015, Level VI) involving 106 clinicians from 31 different hospitals evaluated the current practice of screening for GCIH, the intention to start therapy, and the therapy of choice. Results showed that clinicians were more likely to order BG testing for GCIH for patients with a pre-existing DM diagnosis and patients with a history of random hyperglycemia prior to initiation of GCs. Over half of the clinicians indicated their preference for more lenient glucose goals than the glycemic guidelines set for non-critically ill patients, with a lesser overall tendency to order BGM, as compared to clinicians who aimed at stricter BG level goals. An interesting observation detailed the notion that the more experienced physicians typically chose the more lenient glycemic goals, while the resident physicians opted for stricter glycemic goals. This could suggest that there is a greater concern for hypoglycemia, rather than hyperglycemia, and may even hint towards an inverse relationship between years of experience and adherence to guidelines. The responses could also imply the tendency of physicians to manage more conservatively, potentially relying on endocrinologists to cover glycemic management.

This study by Gerards et al. (2015, Level VI) was limited by the lack of representation of providers from different specialties as the clinicians included internists and pulmonologists. Additionally, there was a low response rate, which potentially gave rise to biased responses as responders may have chosen to participate due to interest in the topic of GCIH.

Despite the inconsistent frequency of BGM, as well as the differing clinician views regarding orders for BGM, all of the data reviewed support the necessity of BGM with GC

therapy. The literature consistently recommended that BGM take place at least once a day, preferably two hours after lunch or before dinner, for patients without DM history because GCs mainly affect postprandial glycemic levels. The frequency of BG checks could be increased to a maximum of four times a day in the presence of persistent hyperglycemia >180 mg/dl within a 24-to 48-hour duration, with subsequent initiation of treatment (Fong & Cheung, 2013; Lansang & Hustak, 2011; Perez et al., 2014; Roberts et al., 2014; Umpierrez et al., 2012). One CPG advised that when BG readings remain <140 mg/dl without insulin therapy for at least 24–48 hours, BGM can be discontinued, while another CPG suggested discontinuation of BGM when BG readings remain <180 mg/dl (Roberts et al., 2014; Umpierrez et al., 2012). The CPG by Umpierrez et al. (2012) provided a reference list of their supporting evidence and is backed by the Endocrine Society and the American Diabetes and Heart Associations; the CPG by Roberts et al. (2014), however, failed to provide a reference list and is based out of the United Kingdom.

Treatment for GCIH

There is a lack of consensus about the most effective GCIH management method for hospitalized patients with cancer. The Grade 6 CPG by Umpierrez et al. (2012) suggested that basal-bolus insulin (BBI) with a starting dosage of 0.3 to 0.5 U/kg/d should be initiated for management of GCIH. A recommendation was also made that continuous insulin infusion was to be administered in cases of persistent hyperglycemia that fail to respond to the BBI treatment (Umpierrez et al., 2012). A retrospective case-controlled study (Gosmanov, Goorha, Stelts, Peng, & Umpierrez, 2013, Level IV) supports the BBI regimen of detemir and aspart as effective and safe options for the management of GCIH in DM patients with hematologic malignancies receiving dexamethasone.

In contrast to these two studies, a randomized prospective clinical trial (Vu et al., 2012,

Level II) showed that the intensive BBI therapy did not improve the outcomes in hyperglycemic patients with acute lymphoblastic leukemia, Burkitt lymphoma, and lymphoblastic lymphoma for those patients who underwent hyper-CVAD chemotherapy, which includes high-dose dexamethasone or methylprednisolone. This study compared BBI therapy of glargine and aspart with conventional care, which comprised non-standardized glycemic control managed at the discretion of the attending physician. Although results may have conflicted based on differing insulin therapies and oncology diagnoses, an emphasis was made on the need for insulin therapy for GCIH management.

Limitations

Aside from those previously mentioned, each publication included minor limitations. Sample characteristics provided the most frequent limitations, mainly involving a small sample size, a focus on specific oncology populations, a lack of consideration for comorbidities, and an inconsistency in the inclusion of patients with preexisting DM. These characteristics threatened both the internal and external validity of the data. Although there was a trend noted by the type of GCs prescribed concurrently with chemotherapy – dexamethasone – not all studies controlled for the various doses and route of medication. Without the aforementioned factors controlled for, BG levels may have been affected differently, leading to variability in results and subsequent treatment.

Summary of Literature Review

Despite its established prevalence, the impact of GCIH on clinical outcomes in oncologic patients is limited. Additional prospective studies regarding the benefits of BGM and optimal GCIH management in oncology patients are warranted. The majority of the data reviewed – ten of 21 articles – was derived from Level IV data, with only one Level II study, three Level VI,

two Level VII, and five systematic and literature reviews. Overall, the publications are deemed to be of fair to good internal validity. The synthesized articles demonstrated the prevalence of GCIH, the need for a consensus and overall awareness of the definition of hyperglycemia, the adverse effects resulting from GCIH that highlight the importance of its management, and the inconsistencies of BGM and GCIH treatment.

Innovation/Objectives

Evidence has emphasized the short- and long-term deleterious effects of both transient and prolonged hyperglycemia and has highlighted the importance of BGM as a paramount precursor to therapeutic interventions for GCIH. The reviewed literature revealed a gap in the perceived significance and proper management of GCIH by healthcare providers. Yet, recent retrospective organizational data from two oncology units highlights variability in GCIH management, suboptimal monitoring and glycemic control, and a gap in the timeliness of therapy, with an underuse of a valuable resource - the Diabetes Team. A practice change was therefore warranted.

The most appropriate EB strategy was the implementation of a standardized protocol for the assessment and management of GCIH. Protocols are helpful guiding tools for providers to recommend appropriate EB clinical treatment modalities in different diagnoses or patient care scenarios. The basis for EB protocols stems from an extensive literature review, with the integration of clinical practice expertise by key stakeholders in the specified practice area (Hall & Roussel, 2014).

The goal of the GCIH protocol was to initiate early BGM and insulin therapy for patients with hematologic malignancies who were prescribed a treatment plan that included GCs in the inpatient oncology units. Although it is inevitable that hyperglycemia will result from GC

therapy, the implementation of an EB protocol was intended to promote patient safety by providing RNs with the knowledge and tools for prompt GCIH recognition and treatment. This protocol aimed to standardize GCIH assessment, enabling early detection of GCIH and decreasing the delay in the initiation of appropriate management. Prompt and proactive management was expected to reduce the incidence of uncontrolled GCIH and prevent adverse outcomes that may result from GCIH.

The protocol was intended to be RN-driven, as one of the goals of this project was to improve the timeliness of GCIH management. According to TJC International (2013), one of the main advantages of RN-driven protocols is greater decision-making power for RNs. This impacts the timeliness of patient care and, subsequently, gives rise to positive effects on safety, patient outcomes, and patient satisfaction. An algorithm was provided to guide staff in the management of inpatients who meet GCIH levels.

In the case of GCIH assessment and management, the plan was to change the process, which involved an inconsistent practice of ordering BGM and insulin when GCs were ordered. As part of the protocol, a BPA (see Appendix B) was initiated to provide an alert that informed the end-user that the patient is on a prescribed glucocorticoid therapy regimen and is at risk for GCIH. The same alert allowed the provider to instantly order BGM, sliding scale insulin (SSI), and/or a Diabetes Team consult. For the RNs, the alert instructed them to obtain orders from the attending physician. The BPA was expected to help minimize the time between initiating GCs and detecting and addressing the resulting hyperglycemia – thereby reducing prolonged untreated GCIH. The BPA was also intended to save time for the providers, as all the orders were made available for selection in one screen.

Because GCs classically play a role in causing exaggerated postprandial hyperglycemia and have a far less effect on fasting glucose, random BG levels are the preferred measurement (Harris et al., 2013; Lansang & Hustak, 2011). However, as the aim of the project was to monitor trends to promptly identify GCIH and manage glycemic levels, BGM ordered through the BPA was scheduled four times a day – before each of three meals (AC) and at bedtime (HS) – for all oncology inpatients with hematologic malignancies who are on a treatment plan with GCs. This schedule also minimized confusion for the RN staff, as it is the typical BGM schedule for inpatients with orders for BG checks.

Due to its immediate onset, efficacy, and easy titration, insulin therapy is the most optimal and preferred treatment method (Brady et al., 2014; Gosmanov et al., 2013; Lansang & Hustak, 2011; Perez et al., 2014; Pilkey et al., 2012). As the objective of the protocol was to reduce the incidence of uncontrolled hyperglycemia, a low-dose regular sliding scale insulin (SSI) was the featured insulin therapy, within the order set to address BG levels >200 mg/dl. A low-dose regular SSI was chosen, as there is limited evidence that tight glycemic control benefits patients being treated for cancer. This insulin regimen was also chosen to reduce the potential for hypoglycemia.

Findings support the fact that hyperglycemia has a rapid onset, typically developing within one to two days of GC therapy initiation (Fong & Cheung, 2013). For the first 48 hours, BGM will likely identify the majority of those patients with GCIH and thus, management should be initiated. Likewise, management could be discontinued if elevated levels do not occur within this timeframe (Roberts et al., 2014; Umpierrez et al., 2012). Therefore, an algorithm was developed as part of the protocol (see Appendix C) to reflect this evidence and provide management guidance for the staff. The algorithm also underwent appraisals by key

organizational groups: The Diabetes Care Committee (DCC), the oncology unit nursing staff, and the Department of Oncology Committee (DOC).

Summary

The magnitude of the impact of GCIH on patient outcomes should no longer be overlooked. The inconsistencies in BGM, as well as the prevalence of hyperglycemia in patients receiving GCs highlight the potential delays in treatment of GCIH. The resulting negative effects of GCIH on the patients are evident in the literature. The reviewed literature, as well as the data collected at the organization, support the need for an EB protocol targeted at the early detection and prompt management of GCIH.

CHAPTER 3: METHODS

Introduction

In accordance with the Iowa Model (Titler et al., 2001), steps 1-4 have been completed, as discussed in Chapter 2. The three remaining steps in the Iowa Model are as follows: 1) The development of a practice change, 2) Implementation, and 3) Evaluation. The purpose of this chapter is to provide an in-depth explanation of these final three steps, covering details of the action plans in each stage, including the description of the practice change, definitions, the sampling plan, the data collection procedures, and plans for evaluation. Prior to providing this explanation, it will be noteworthy to first revisit the driving force behind this DNP project by reviewing the objectives of the project through the patient population, intervention, comparison intervention, and outcome (PICO) format, and the purpose statement.

Objectives

P-Patient Population

The target population was the adult oncology patients with hematologic malignancies who were on an active treatment plan that included GCs. These patients were admitted or transferred to and discharged from either of the two 24-bed medical/surgical/telemetry inpatient oncology units at the tertiary care center.

I-Intervention

The intervention was the implementation of an EB protocol involving an algorithm that guided staff in the assessment and management of GCIH. This protocol also included a corresponding BPA that linked the GC order with an alert that allowed the provider to order BGM, SSI, and a Diabetes Team consult.

C-Comparison Intervention

The intervention for this project was compared to current practice, which involved no established GCIH protocol.

O-Outcome

The outcome goal for this project was a 25% improvement in the baseline rates of BGM, insulin orders, consults to the Diabetes Team, and incidences of uncontrolled hyperglycemia (>180 mg/dl). This would reflect an overall reduction in the delay of detection and management of GCIH.

Purpose

The purpose of developing and implementing an EB protocol was to standardize the BGM and SSI, in order to promote early GCIH detection, as well as initiate appropriate management strategies to reduce the rates of uncontrolled hyperglycemic episodes experienced by the inpatient hematologic malignancy population receiving GCs.

Practice Change Description

There was no set protocol in the inpatient setting for the assessment and management of GCIH. An entirely separate order for BGM, an insulin regimen, or a Diabetes Team consult from the GC order would need to be placed by the provider, and only if they are concerned about the risk of GCIH. The background data featured in Table 1 and Table 2 supports how this order system has led to inconsistencies in care, as certain patients may have not been appropriately assessed for GCIH. The process is detailed as follows:

1. Patient with a hematologic malignancy diagnosis is admitted or transferred to the inpatient oncology unit.
2. The oncologist places orders for a treatment plan that includes GC therapy.

3. The oncologist may or may not place separate orders for BGM, insulin orders, or a Diabetes Team consult.
    a) If BGM is ordered, RN staff performs BGM, but may or may not notify the provider of elevated BG levels.
    b) If insulin is ordered, there is no standard type of therapy.
    c) Diabetes Team is rarely consulted.

The Practice Change

The proposed GCIH assessment and management protocol entailed a BPA (see Appendix B) that appeared for the RN and provider when the targeted patient chart was opened. Criteria for the targeted patient charts included patients on the two oncology units with a diagnosis of a hematologic malignancy, with an active treatment plan that included GCs, and with no BGM orders. For patients who do not meet all three parts of this criteria, the BPA would not be activated.

When the BPA appeared for the RN, the RN was instructed to select the "RN to obtain orders from Attending Physician" option, which defaulted all options to "Do Not Order," and call the provider for the orders. This also prompted the BPA to stop firing for the following eight hours. Thereafter, the RN or provider would place the corresponding orders. When the BPA fired for the provider, the provider could place the orders themselves.

If BGM or SSI orders were placed by either the RN or provider, the BPA firing stopped. However, if the provider did not want any orders, the "Not applicable" selection would be chosen the next time the BPA fired, causing the BPA to not fire for the next 999 hours. A Diabetes Team Consultation order could also be selected at any time, however, it was recommended to be placed only when BG levels remained greater than 180 mg/dl for at least 24

hours, despite treatment with SSI orders.

The corresponding algorithm, as seen in Appendix C, provides guidance for the staff regarding GCIH management. It indicates when and who to escalate care to, based on established BG level readings. In the event that all of the patient's BG results remain ≤140 mg/dl for a consecutive 48-hour period of BGM and without the use of insulin therapy, BGM can be discontinued. The RN would need to obtain this discontinuation order from the provider. Resuming BGM would be considered if the patient developed symptoms of hyperglycemia, if morning serum BG levels were noted as elevated (>140 mg/dl) in the basic metabolic panel results, or if GC dosing increased.

Conversely, if the patient had an AC BG level ≥140 mg/dl or HS BG level ≥180 mg/dl for at least two readings within the first 24 hours of BG monitoring, the patient would meet the criteria of GCIH diagnosis. At this time, the RNs would continue BGM and administration of SSI, while keeping close attention to BG levels. If, despite the SSI therapy, BG levels consistently remained ≥180 mg/dl for 24 hours, the Diabetes Team should be consulted to enhance GCIH management. Overall, the algorithm provides the needed guidance to appropriately direct care in regards to GCIH in a timely and standardized manner.

Characteristics of the Innovation

Rogers (2003) explains that the perception of the characteristics of innovation by prospective adopters helps to determine their level of willingness and involvement, as reflected by the rate of adoption. Accordingly, the potential of success in adopting the practice change will largely be determined if the following five characteristics are satisfactorily addressed: 1) Relative advantage, 2) Compatibility, 3) Complexity, 4) Trialability, and 5) Observability. The following sections will review these five innovation attributes in relation to the GCIH assessment

and management protocol.

Relative advantage. For the chief users, the oncologists and the RN staff, a key relative advantage of this practice change is convenience. The protocol was intended to save extra steps – and thus, time - for oncologists when placing orders. These conveniences would expectantly lead to prompt management of the GCIH and help to mitigate its negative outcomes.

The protocol was designed to be RN-driven, which aimed to empower RNs to properly assess BG levels and collaborate with the providers to obtain orders when necessary. This could be viewed as another opportune, timesaving feature of the protocol for the oncologists. According to TJC International (2013), one of the main advantages of RN-driven protocols is greater decision-making power for RNs. This impacts the timeliness of patient care and, subsequently, gives rise to positive effects on safety, patient outcomes, and patient satisfaction.

In regard to the relative advantage for patients, a feature of the protocol involved discontinuation of BGM when all BG levels remain ≤140 mg/dl for 48 hours without insulin therapy. The purpose of this distinction was to promote patient satisfaction, as patients would more than likely prefer to not have their fingers unnecessarily punctured up to four times per day. Ultimately, the relative advantage for patients would be the potential decrease in the number of uncontrolled hyperglycemic episodes (≥180 mg/dl), as well as ALOS, primarily through a more efficient method of glycemic control.

Compatibility. In examining the compatibility aspect of the project, the focus was on the needs of the adopters. The physicians at the Cancer Center initially raised the issue of GCIH after noting an increasing trend in hyperglycemia within their oncology outpatients receiving chemotherapy with GCs as part of their treatment. In March 2016, the Cancer Center reached out to the inpatient Diabetes Team and a partnering Cancer Center to inquire about their use of

management guidelines specific to GCIH. This inquiry revealed that GCIH protocols had not been established with either group. With further investigation into the inpatient oncology population that received GCs, data collection revealed variability in care delivery, the lack of timely management, and suboptimal glycemic control. The variability was evidenced by the underuse of the Diabetes Team, inconsistencies in BGM orders, and BG levels as high as the 400 mg/dl range. Therefore, the protocol was intended to meet multiple needs for the oncology department.

Delays in treatment remain one of the top 10 sentinel events in the nation, as recorded by TJC (The Joint Commission, 2016). The Endocrine Society, as well as TJC, advise GCIH assessment and management. The protocol would assist to meet organizational goals and to be in alliance with standards outlined by the Endocrine Society and the TJC.

Finally, in order to maintain their accreditation, the Oncology group must meet the Commission on Cancer Standard 1.5 Clinical each calendar year. This standard involves the cancer committee establishing, implementing, and monitoring at least one clinical and one programmatic goal for endeavors related to cancer care. This practice change had been approved by the committee to help fulfill this standard.

Complexity. The degree of complexity for this practice change was projected to be low for the providers, as the BGM and SSI orders would be updated to link with the GC orders through the BPA. Therefore, the oncologists would resume their usual process of ordering treatment plans, without needing to place any additional effort on simultaneously addressing GCIH.

The complexity level for the RNs was aimed to, likewise, be low, as the skills of BGM and insulin administration are considered routine nursing tasks. Furthermore, at this practice

setting, RNs can delegate BGM to nursing assistants, who are competent in performing this task as well. The competencies to review lab results and subsequently report and initiate care when necessary are also established practices for the RNs. This protocol would merely provide guidance to appropriately direct care in a timely and standardized manner. However, one complex aspect may have involved the shift in mindset towards recognition and interpretation of BG levels before proceeding to the next step in the algorithm.

Trialability. In considering trialability of the practice change, the implementation of the protocol was planned for a short trial period of four months and piloted on focused diagnoses, rather than all oncologic inpatients at once. As collectively suggested by the oncologists during the DOC and Cancer Steering Committee (CSC) meetings, a pilot should focus on hematologic malignancies, as patients of these diagnoses are prescribed the highest doses of GCs. With ongoing evaluation, modifications to the protocol could easily be achieved in preparation for the next steps of implementation, and involve all oncologic inpatients receiving GCs. Moreover, these initial achievements would ultimately substantiate extending the protocol to the whole organization for all types of patients receiving GC therapy. Equally, if the protocol proved to completely fail in functioning with the staff's workflow, was met with disapproval by patients, or exhibited worsening results, it could and would easily be revised or discontinued.

Observability. The protocol was expected to project observability for the adopters through the increase in BGM and insulin orders in their patients, with an ensuing reduction in the frequency of uncontrolled hyperglycemia levels. The algorithm was displayed in various areas of the unit for easy access and increased visibility. As the protocol was projected to progressively become adopted and immersed in the staff's routine, it was anticipated that peer accountability would ensue to ensure prompt detection of GCIH and that the proper steps are

taken to manage the patients' BG levels.

Definitions

While conceptual definitions describe what a concept means, operational definitions specifically define how the concept is measured using terms that can be counted and categorically described (O'Brien, Trindell, Tarpley, & Wiberg, 2014). This section addresses the operational definitions of the impact and process evaluations. Conceptual and operational definitions are listed in Table 6.

Table 6

Conceptual and Operational Definitions of the Impact and Process Evaluation Outcomes for the Baseline and Intervention

Term	Conceptual	Operational
Impact evaluation		
Uncontrolled hyperglycemia episode	Occurrence of abnormally high blood glucose (BG) level	Occurrence of BG level ≥180 mg/dl
Average length of stay (ALOS)	Average duration of a hospitalization, measured in days	ALOS measured by days
Process evaluation		
Blood glucose monitoring (BGM) orders	A method of monitoring individual patterns of BG levels (American Diabetes Association, 2016)	Provider orders for BGM four times a day: AC and HS *Exception: Any variation of BGM orders
Insulin therapy orders	A critical part of treatment for people diabetics to maintain BG levels within target range (Mayo Clinic, 2016).	Provider orders for regular (Humulin R) low-dose SSI, which starts insulin dosing at >200 mg/dl AC and HS *Exception: Any variation of rapid- or short-acting insulin orders
Diabetes Team consult orders	A referral to a healthcare team specializing in diabetes care	An order on the patient's chart indicating consultation to the inpatient Diabetes Team has been placed
Adherence	The act, action, or quality of adhering (Merriam-Webster, 2017).	User adherence to the protocol is exhibited by the presence of BGM orders, insulin therapy orders, or Diabetes Team consults

Note: The operational definition of each baseline is the measurement taken before the intervention.

Impact evaluation

The impact evaluation explores the relationship between the GCIH protocol and the overall uncontrolled hyperglycemia rates and ALOS days in the adult oncology inpatients with hematologic malignancies receiving GCs. The operational definition for uncontrolled hyperglycemia episode is an occurrence of BG level ≥180 mg/dl. The operational definition for ALOS is measured in days. The ALOS is linked to the variable, Diabetes Team consults, that is being assessed of the population, as well as the highest BG level reading during the hospital stay.

Process evaluation

The process evaluation measures user adherence to the new protocol for the assessment and management of GCIH. User adherence to the protocol is exhibited by the presence of BGM orders, insulin therapy orders, and Diabetes Team consults, as these three proxy measures are directly related to the correct use of the protocol.

The operational definition for a BGM order is a provider order for BGM that takes place four times a day, AC and HS. An exception would be any variation of BGM orders such as twice a day or every six hours. A lack of BGM is considered as non-adherence to the protocol.

The operational definition for insulin therapy orders is a provider order for regular (Humulin R) low-dose SSI, which starts insulin dosing at BG levels >200 mg/dl, AC and HS. An exception would be any variation of rapid- or short-acting insulin orders; otherwise, an absence of insulin therapy is considered as non-adherence to the protocol.

The operational definition for a Diabetes Team consult is an order on the patient's chart indicating that a consultation with the inpatient Diabetes Team has been placed. The preferred scenario involves a Diabetes Team consult for eligible patients who experience persistent uncontrolled hyperglycemia, BG levels remaining greater than 180 mg/dl for at least 24 hours,

despite treatment with SSI orders. A presence of a Diabetes Team consult would be an indication that the staff understands the proper use of the protocol. However, in the event that users placed the consult even when the patient did not meet the aforementioned eligibility, these cases will still be considered as an indication of user adherence. This exception was made to promote early consultation, an ideal option over late or no Diabetes Team consultation for these patients who are at risk for GCIH. An absence of a Diabetes Team consult for patients who meet eligibility for consultation indicates user non-adherence.

The Sampling Plan

Setting

Practice setting. The GCIH assessment and management protocol was implemented on two inpatient oncology units at a large tertiary care center in Honolulu, Hawai'i. Together, these units can accommodate a total of 48 patients of the medical/surgical/telemetry level of care, specializing in assisting those who have an oncologic history or admission diagnoses. The total nursing staff for the two units is approximately 100 RNs, as well as 20 nursing assistants. A multidisciplinary team is able to provide direct care for each patient. This team typically includes: 1) Physicians from various specialties, 2) The nursing staff, who each member carries a 3-5 patient workload during their shift - a number that varies based on acuity levels and staffing availability, and 3) Nursing Assistants. Ancillary support for the oncology units includes the unit secretaries, a social worker, a case manager, an RD, the oncology pharmacists, and specialty care teams (i.e., diabetes, pain and palliative, wound care, etc.). A nurse manager and a clinical operations manager oversee all of the unit staff. All units within the organization practice a shared governance structure, with a unit council that serves as the communication liaison between staff and upper management.

Sample

Sample size. The sample size is intended to include all the patients who met the inclusion criteria of the evaluation. This implementation intended to be a 100% sample.

Inclusion criteria.

Impact evaluation. This evaluation focused on adult oncology patients with hematologic malignancy diagnosis of the medical/surgical or telemetry level of care. These patients were admitted or transferred to and discharged from either of the inpatient oncology units, between September 1, 2017 to December 31, 2017, and who were prescribed an active treatment plan that included orders for GC therapy.

Process evaluation. This evaluation focuses on the process of implementing the practice change and, thus, focuses on the users of the protocol. The users included all RN staff and oncologists on the two oncology units, who provided care for the inpatients who met the impact evaluation criteria.

Recruitment/marketing plan. The recruitment phase was designed with the intent to ensure the interest and ultimately, the engagement of the stakeholders in the development, implementation, and sustainability of the practice change. Practice change often requires the involvement of diverse skill sets to be successful. A list of the core stakeholders and their contributions to the evaluation plan is delineated in Table 7. In order to gain recruitment of key stakeholders, it is important to have a stakeholder engagement plan in place that attracts a multidisciplinary team.

Table 7

How Each Stakeholder Group Will Contribute to the Evaluation

Stakeholder	Increasing credibility of the evaluation	Helping with the design of the evaluation plan	Implementing the evaluation's intervention	Advocate for changes to implement evaluation findings	Fund or authorize action to implement evaluation findings
PU DNP student	X	X	X	X	
PRU Inpatient Diabetes Team APRN/DNP project content expert	X	X	X	X	X
P Data Analysts	X	X	X		
PRU Cancer Committees	X	X		X	X
PRU Diabetes Care Committee	X	X		X	X
PRU Unit RNs and Oncology Unit Nurse Managers				X	X

Note. P, R, U describes how each stakeholder is involved in the project: P=Program operations**,** R=Receive services, U=Users of evaluation findings

Marketing tools should be developed to optimize awareness and recruitment. With this in mind, it became clear that a shorter project title would be more effective in engaging stakeholders. The goal here was not only to create simplicity, but also to equally generate memorable qualities. Thus, the slogan for the protocol was, "Say bye to high…GCIH." This tagline was fitting since the overall goal of the project was to reduce the rates of uncontrolled GCIH. The accompanying visual included a hand in a waving motion, as if to say "bye," as seen in Appendix D. This image was featured on the educational tools for the staff. The Diabetes Team APRN approved both the slogan and logo.

Data Collection Procedures

Data collection incorporated running data sets based on the established codes from electronic medical records (EMR) that identify the specified variables of the targeted population

over the baseline and post-implementation time frames. The Diabetes Team's designated data analyst managed the impact and process evaluation data. The data analyst holds previous experience with data sets and is knowledgeable regarding proper data collection procedures per organizational policy. The proper protocols have been followed in accordance with HIPAA regulations in accessing medical records and ensuring that the confidentially of the data is maintained when shared with the DNP student and content expert for educational purposes. Charts were not individually reviewed and no individual patient chart was targeted.

Process and Outcome Variables

A process evaluation was employed to ensure that the intervention was implemented accurately. User adherence was assessed via three proxy measures that are directly related to the correct use of the protocol: the number of BGM orders, insulin orders, and Diabetes Team consults. These proxies are positioned as intermediate variables in the impact evaluation because of their influence on two prominent measures of patient outcomes: 1) A decrease in hospital LOS and 2) The rate of uncontrolled hyperglycemia episodes.

The impact evaluation used a T1-T2 design. The T1-T2 design assesses the impact of the intervention (independent variable) on the outcomes (dependent variables), by means of comparing the baseline data (T1) with the post-implementation data (T2). This DNP project's impact evaluation explored the relationship between the GCIH protocol and the overall hyperglycemic rates in adult oncology inpatients receiving GCs. The T1 was defined as the number of uncontrolled hyperglycemia episodes and was compared to the T2 data. As suggested by the DOC and DCC, ALOS will also be measured to investigate the potential influences of the protocol.

Because the protocol was implemented in August, baseline data will range from April to July 2017, while post-implementation data will cover September to December 2017. The data was collected and analyzed in January 2018.

Program Evaluation Plan

Evaluation Question

Will an evidenced-based protocol for the assessment and management of GCIH increase the rates of BGM orders, insulin orders, and Diabetes Team consults, and reduce the overall rates of uncontrolled hyperglycemic episodes and hospital ALOS by 25% in adult oncology inpatients receiving GC therapy, on the oncology inpatient units over a 4-month period?

Data Analysis

With the completion of the implementation and the collection of data, a two-week period in January 2018 was allotted for data analysis. For both the impact and process evaluations, descriptive statistics were utilized. The outcomes involved the calculated difference between the T1 and T2 rates.

The goal was to gain a 25% improvement in all outcome rates compared to baseline. However, it is important to reflect on why the outcomes were or were not reached. The DNP student and content expert analyzed the data and jointly interpreted the outcomes in preparation for presentation to the stakeholders within the succeeding two months.

Impact evaluation. The data analysis plan of the impact evaluation of the GCIH protocol involved comparison of the T1 and T2 measures by subtracting the calculated T1 rates of uncontrolled hyperglycemia and average ALOS days from the calculated T2 rates. The data set regarding uncontrolled hyperglycemia will demonstrate the total number of patients who met inclusion criteria and experienced a BG level ≥ 180 mg/dl. The data will be divided into

categories designated by the following BG level ranges: 180-299, 300-399, and >400. The data set regarding ALOS will exhibit the calculated days for the patients who met the inclusion criteria. Both data sets were further sub-divided to demonstrate the outcome values based on the presence of a Diabetes Team consult in order to assess any correlations. An improvement in the rates would mean a decrease in the number of patients experiencing uncontrolled hyperglycemia and a shorter ALOS post-implementation.

Process evaluation. The process evaluation data analysis plan similarly entailed a comparison of the calculated rates of the baseline and post-implementation outcome measures, but with a particular focus on the BGM orders, insulin orders, and Diabetes Team consults to measure user adherence. User adherence to the protocol is demonstrated by an increase in the rates of BGM orders, insulin orders, and Diabetes Team consults.

Resources

Financial

Formal financial funding for the DNP project was not provided. The implementation and evaluation of the GCIH protocol were imbedded into the daily routines of the staff RNs, oncologists, Diabetes Team, and Diabetes Team data analyst, without additional monetary compensation for the added workload. Additionally, the DNP student was responsible for personally funding the production of educational materials for the staff.

Human

Educational in-services for the staff, as well as multiple presentations of the project to the various approving committees, were completed by the DNP student and the content expert. Two staff RNs from the oncology units were recruited to assist as a staff-level resource for the

protocol. The IT department and oncology pharmacists helped to integrate the protocol into the EMR through the BPA.

The implementation phase of the GCIH protocol involved the oncology unit staff including the oncologists, the nurse managers, and approximately 100 staff RNs. The Diabetes Team were also a key resource during implementation when consults were placed.

The evaluation stage relied heavily on the expertise of the Diabetes Team data analyst, as well as the Clinical Data Analysts from the organization's Center for Outcomes Research and Evaluation.

Time

Implementation commenced in August 2017 with staff education of the protocol. These educational in-services were 5-10 minutes in duration, however, involved multiple groups of RNs at varying times depending on availability based on patient care, and during varying nursing shifts. The goal was to provide education to 100% of the oncology unit RN staff by the end of August. The BPA was officially embedded into the EMR in October 2017. Therefore, the entire implementation phase for the purpose of data collection spanned the four-month period from September 2017-December 2017.

An advanced notice was provided to the data analysts as to the timeline and when his or her services would be required. This strategy helped to prepare the analyst for the added workload. A two-week period in January 2018 was allotted for data collection. Thereafter, the DNP student and content expert analyzed the results for dissemination to the stakeholders within the succeeding two months through meetings and organizational forums.

Physical

To address the resource of physical space, educational GCIH protocol sessions conducted by the DNP student and content expert took place in the oncology units within the nursing station. Access to computers is available for staff use at all times. The data analyst has her own office and the necessary computer programs to perform data collection. Codes that identify the requested variables and patient population were established and used to extract the data from the EMR**.** The content expert has her own office to complete analysis of the data with the DNP student.

Timeline

An overview of the timeline for the project is featured in Table 8 below.

Table 8

Timeline of the Implementation and Evaluation of the DNP project

	Jun '17	Jul '17	Aug '17	Sep '17	Oct '17	Nov '17	Dec '17	Jan '18	Feb '18
Successful defense proposal	X								
Develop and distribute marketing products		X	X						
Staff education			X						
Collect baseline data								X	
Implement protocol				X	X	X	X		
Obtain feedback regarding protocol								X	
Collect post-implementation data								X	
Analyze data								X	
Make revisions to protocol								X	X
Disseminate results								X	X

Human Subjects Considerations

This DNP proposal of the GCIH assessment and management protocol has been designed in such a way as to protect the rights of any human subjects involved in the project. As a quality improvement initiative, standard, EB practices were implemented. The DNP student has completed the University of Hawaii required Collaborative Institutional Training Initiative (CITI) course in Human Subjects Protection. A committee consisting of faculty and clinical experts reviewed this proposal to ensure there was adequate human subjects protection. There was no additional risk beyond standard practice. Person-identifiable information will not be collected. The project addressed each of the five nursing ethical tenets: 1) Autonomy, 2) Non-maleficence, 3) Beneficence, 4) Justice, and 5) Veracity. Each of these tenets will be explained in more detail in the following sections.

Autonomy

Autonomy describes an individual's right to self-determination, with the ability to make decisions about their life without external influence from others (Silva & Ludwick, 1999). The project allowed for participant autonomy through the patient's right of refusal of care. The patient was not mandated to participate in the GCIH protocol.

Non-maleficence

Non-maleficence is defined as to do no harm, where the provider and nurse have the responsibility to protect the patient's safety (Silva & Ludwick, 1999). The providers had the ability to discontinue or modify the BGM or insulin orders based on their clinical judgment, order duplication, or practice preference. The provider was able to defer their participation in the protocol at any time, if deemed to cause unsafe conditions for the particular patient's health status, or if it affects patient satisfaction.

Beneficence

Beneficence means to promote good and to act in accordance with an individual's welfare (Silva & Ludwick, 1999). This ethical tenet was addressed by the overall aim of the GCIH protocol, to reduce prolonged untreated hyperglycemia that may lead to negative outcomes for the oncology patients. The GCIH protocol was also projected to provide improved direction for staff in the management of GCIH.

Justice

Justice involves providing each individual fair and equitable access to care and resources (Silva & Ludwick, 1999). The project addressed the ethical tenet of justice, as there was no randomization of the sample population to different treatments. All adult oncology patients who met the previously outlined criteria received treatment as guided by the same GCIH protocol.

Veracity

Veracity is the principle of telling the truth with full disclosure by providers to patients (Silva & Ludwick, 1999). This ethical principle was addressed through staff and patient education of the protocol and notification of involvement in the implementation of the practice change.

Limitations

Despite efforts to account for risks, there are factors in addition to the proposed protocol that may influence outcomes. Within the setting of a quality improvement initiative, it is not realistic that all conditions can be controlled.

Sample Size and Time

Firstly, based on the fluidity of the practice change setting, it is not possible to predict the precise number of patients who will meet the protocol criteria over the course of the four-month

time frame. Secondly, the two units can only accommodate a total of 48 patients at any given time. This may lead to a small sample size and affect external validity. Furthermore, the four-month implementation phase may not be a sufficient amount of time to adequately engage the users of the innovation to achieve a sustained practice change.

Patient Right to Refusal of Care

For those patients who do not regularly have their BG levels checked, (i.e., they have not had a history of DM) they may refuse to have their fingers pricked four times a day, based on the protocol indications of BGM. In that case, it would be unethical to have these patients participate in the protocol against their wishes. Therefore, the protocol may be discontinued, again affecting outcomes. Increasing the patients' awareness and knowledge of the protocol, as well as the importance of managing GCIH, through patient education from the staff will be highly encouraged to minimize situations such as this.

Staffing Considerations

The expectation of the protocol is that once a Diabetes Team consult is placed, hyperglycemia management is immediately initiated. However, this is may not always be the case, based on issues such as staffing levels or workload at the time of the consult. Members of the inpatient Diabetes Team who can assist with hyperglycemia management include two APRNs, two Endocrinologists, and one pharmacist. These five members provide services hospital-wide; therefore, hyperglycemia levels may not be promptly managed, depending on patient load, which may affect data outcomes.

Variance in Clinical Judgment and Preferences for Administrative Autonomy

Although the protocol called for a BPA that recommends the orders of BGM, insulin, and Diabetes Team consultation, oncologists still have the capability of deselecting any of these

options or to discontinue the orders based on their clinical judgment. In other words, they are not bound to the protocol, as it is not an established organizational policy. Given the fragile health state in which oncologic patients face, the potential onset of hypoglycemia episodes could act as a deterrence from the protocol. In addition, those oncologists who prefer managing all of their patients' care orders themselves may not feel comfortable with sharing that control and again may defer their participation in the protocol. Those decisions will likely affect outcomes. In line with this, the responsibility to escalate care to the Diabetes Team based on consistently elevated BG levels ≥180 mg/dl also lies with the RNs or providers to recognize and act accordingly, as per the protocol.

Factors Impacting ALOS and hyperglycemia

ALOS will be concurrently evaluated to assess for any correlation with BG levels and Diabetes Team consults. However, this correlation may be an inaccurate measure, as ALOS could also be influenced by many other variables such as a patient's comorbidities. Additionally, hyperglycemia experienced in this patient population could also be similarly influenced by such variables as comorbidities, other medications, or stress, all of which are not accounted for in the scope of this quality improvement project.

Summary

Chapter 3 has described the characteristics of the protocol and has subsequently covered the plans for implementation and evaluation, in accordance with the Iowa Model. Despite the presence of limitations due to a lack of control over certain aspects of this EB quality improvement initiative, the overall goal remained to create a standardized protocol for providers and staff to follow. This protocol aimed to promote early GCIH detection and initiation of

appropriate management measures to reduce the rates of uncontrolled hyperglycemic episodes and ALOS experienced by the inpatient hematologic malignancy population receiving GCs.

CHAPTER 4: RESULTS

Objectives

The final step of the Iowa Model (Titler et al., 2001) is the evaluation of the project, which involves monitoring and analyzing of the structure, process, and outcome data. Chapter 4 will present the results of both the impact and process evaluations. An examination of the results can assist in determining whether or not the practice change achieved the proposed objectives and help to identify areas for improvement. A description of the resulting sample, as well as a trend analysis for the process and outcome variables, are explored. A reflection of the evolution of the project will also be featured through review of the expected versus actual outcomes, along with facilitators and barriers that were encountered throughout the completion of this DNP project.

Description of Sample

The sample population for the project consisted of adult oncology inpatients with ICD-10 diagnosis codes for hematologic malignancies, on an active treatment plan that included GCs, and who were admitted or transferred to and discharged from either of the two oncology units between the specified timeframe. The baseline group consisted of 75 patients who met criteria between April 1, 2017 and July 31, 2017. The post-implementation group comprised of 49 patients who met criteria between September 1, 2017 and December 31, 2017.

Trend Analysis for Process and Outcomes Variables

Analysis of the process, as well as outcome variables of the practice change, was completed by means of process and impact evaluations. The variables that were measured in the process evaluation were BGM orders, insulin orders, and Diabetes Team consults. The variables that were measured in the outcome evaluation were uncontrolled hyperglycemia episodes and

ALOS days. The results of the evaluations involved the calculated difference between the T1 and T2 rates of the sample and are described in the subsequent sections.

Process Evaluation

An improvement in the process evaluation variables: BGM, insulin orders, or Diabetes Team consults, would reflect user adherence to the protocol. These orders are directly related to the appropriate use of the protocol, as they needed to be proactively initiated by the users. An improvement would be indicated by an increase in the numbers of these orders in the post-implementation data as compared to the baseline.

The process evaluation (see Tables 9, 10, and 11) revealed a 3% improvement in BGM orders, as well as an 8% increase in Diabetes Team consults. There was a 6% decrease in insulin orders.

Table 9

Baseline (T1) – BGM Orders, Insulin Orders, and Diabetes Team Consults

Response	BGM Orders	Insulin Orders	Diabetes Team Consults
Yes	42	27	3
No	33	48	72
Totals	75	75	75

Table 10

Post-implementation (T2) - BGM Orders, Insulin Orders, and Diabetes Team Consults

Response	BGM Orders	Insulin Orders	Diabetes Team Consults
Yes	29	14	6
No	20	35	43
Totals	49	49	49

Table 11

T1-T2 Process Evaluation: BGM Orders, Insulin Orders, and Diabetes Team Consults

	% BGM orders	% Insulin Orders	% Diabetes Team consults
Baseline (T1)	56%	36%	4%
Post-implementation (T2)	59%	29%	12%
Change Δ	+3%	-7%	+8%

Impact Evaluation

An improvement in the impact evaluation would be defined as a reduction in the number of uncontrolled hyperglycemic episodes, as well as a decrease in ALOS days in the post-implementation data as compared to the baseline. The improvement would reflect an overall reduction in the delay of detection and management of GCIH.

The impact evaluation presented a 3% decrease in total uncontrolled hyperglycemia episodes (See Tables 12, 13, and 14). There was an improvement in Diabetes Team consults that appropriately met criteria, as supported by a 54% increase in the number of uncontrolled hyperglycemia episodes with a diabetes team consult. A 3% decrease in the number of overall hypoglycemic episodes was also noted.

Table 12

Baseline (T1) – BG Levels in Relation to Diabetes Team Consults

Consult	BG ≤70	BG 71-179	BG 180-299	BG 300-399	BG ≥ 400	Grand Total
Yes	12	6	50	11	0	79
No	14	160	173	43	11	401
Total	26	166	223	54	11	480

Table 13

Post-implementation (T2) – BG Levels in Relation to Diabetes Team Consults

Consult	BG ≤70	BG 71-179	BG 180-299	BG 300-399	BG ≥ 400	Grand Total
Yes	5	60	125	34	11	235
No	7	101	50	5	0	163
Total	12	161	175	39	11	398

Table 14

T1-T2 Impact Evaluation: Hypoglycemia and Uncontrolled Hyperglycemia

	% Hypoglycemia	% Uncontrolled Hyperglycemia	% Uncontrolled Hyperglycemia with consult
Baseline (T1)	6%	60%	22%
Post-implementation (T2)	3%	57%	76%
Change Δ	-3%	-3%	+54%

The impact evaluation also revealed that during the post-implementation period, the calculated ALOS days (See Tables 15, 16, and 17) decreased by four days for those without a Diabetes Team consult and increased by 35 days for those with a Diabetes Team consult. Overall, ALOS increased by six days across both groups.

Table 15

Baseline (T1) - ALOS in Relation to Diabetes Team Consults

Consult	Cases	ALOS (days)
Yes	3	35
No	39	24
Total	42	25

Table 16

Post-implementation (T2) – ALOS in Relation to Diabetes Team Consults

Consult	Cases	ALOS (days)
Yes	6	70
No	23	20
Total	29	31

Table 17

T1-T2 Impact Evaluation: ALOS

	Overall ALOS days	ALOS days without consult	ALOS days with consult
Baseline (T1)	25	24	35
Post-implementation (T2)	31	20	70
Change Δ	+6	-4	+35

The LOS days based on the highest BG level reading during the hospitalization were also noted to evaluate any potential correlation between severe hyperglycemia and LOS (See Tables 18 and 19). In both the baseline and post-implementation data, the ALOS days were generally higher in patients meeting uncontrolled hyperglycemia levels than those with controlled levels of less than 180 mg/dl. These results emphasize that patients that experienced uncontrolled hyperglycemia often have prolonged hospitalizations.

Table 18

Baseline (T1) –ALOS Days in Relation to Highest BG Levels

	BG <180	**BG 180-299**	**BG 300-399**	**BG ≥ 400**
Cases	13	14	8	7
Length of stay	264	334	127	284
ALOS	21	24	16	41

Table 19

Post-implementation (T2) – ALOS Days in Relation to Highest BG Levels

	BG <180	**BG 180-299**	**BG 300-399**	**BG ≥ 400**
Cases	13	9	2	5
Length of stay	198	206	46	427
ALOS	**16**	**23**	**23**	**86**

Evolution of Project

In developing the quality initiative, a plan was established in accordance to The Iowa Model (Titler et al., 2001) to guide the successive phases of the project. Objectives were also set for each phase. However, flexibility was key with execution of the practice change in order to adapt to the unanticipated organizational and stakeholder demands. Table 20 outlines the expected versus actual outcomes in relation to the phases of the project based on the IOWA model steps. A description of noted facilitators and barriers to this DNP project will also follow.

Expected versus Actual Outcomes

Table 20

Expected versus Actual Outcomes of the DNP Project

	Expected outcomes	Strategies	Actual outcomes
Forming a team	• Prior to August implementation, recruitment of four staff RNs on each of the oncology units,	• Discussed with nurse managers the potential RN candidates to recruit	• Two day-shift RN staff from one unit finally agreed to assist in October (after implementation)

	ideally two who work the day shift and two who work the night shift, will be sought to assist as a staff-level resource for the algorithm. • 100% support from Oncologists and Diabetes Team	• Emailed and personally contacted staff on units; advertised opportunity as a means of professional development through the clinical ladder program • Attended unit council meetings, department meetings • Presented project with triggers, supporting data, and plan of action	• Approval of project was obtained by Oncology and Diabetes groups, however, with some reserve from select oncologists due to lack of strong supporting evidence of benefit
Staff education of protocol	• 100% RN staff educated on the protocol within month of August	• In-services for staff on unit throughout month of August • Algorithm posted on unit • Info. added to the unit's morning announcements	• RN staff education limited to one week in August per nurse manager's request. • Occurred throughout the week of 8/20/17, twice a day, seven days straight, approximately 4 hours each day. In-services were ~5-10 minutes in duration depending on how busy the staff were. • ~70% Oncology unit staff and a few Float Pool and Crisis RN staff received education
BPA	• Roll out BPA by August 21st, in concurrence with the staff education	• Obtained service request approval for EMR changes in March 2017	• BPA production was not fully initiated until after August due to

		• Attended multiple oncology meetings in 2017 for feedback and approval of BPA • Closely worked with IT and Pharmacist on design and trial of BPA	organizational upgrade in EMR • BPA did not go live until October 31.
Sample size	• Sample size of approximately 100 patients, based on initial background data from 1/1/2016 and 8/31/2016, that showed 527 patients. This sample, however, comprised of all oncologic diagnoses.	• Limited sample criteria to hematologic malignancies per Department of Oncology request as pilot project	• Baseline sample: N=75 • Post-implementation sample: N=49
Outcomes	• **Process evaluation:** 25% improvement in the baseline rates of BGM, insulin orders, consults to the Diabetes Team. • **Impact evaluation:** 25% improvement in the baseline rates of uncontrolled hyperglycemia (>180 mg/dl) and ALOS days.	• Developed protocol • Staff education on protocol (evidence based-algorithm and BPA), • Implementation of BPA in EMR	**Process evaluation:** BGM- 3% increase Insulin orders- 6% decrease DM Team consults- 8% increase **Impact evaluation:** Uncontrolled hyperglycemia episodes- Overall 3% decrease ALOS days- Overall 6-day increase

Facilitators

Organizational goals. As a major teaching hospital, the tertiary care center was highly supportive of and continuously promotes the integration of EB practice in patient care delivery.

The project aligned with two of their organizational goals: 1) Patients First. Be a national leader in quality & patient safety and 2) Provider of choice. Ensure the right care, at the right place, at the right time. Therefore, the project was approved by the organization's Clinical Ladder Oversight Committee who reviews performance improvement, research, and evidence-based practice projects prior to implementation.

The oncology group, which includes DOC and CSC, is required to meet the Commission on Cancer Standard 1.5 Clinical each calendar year. This standard involves establishing, implementing, and monitoring at least one clinical and one programmatic goal for endeavors related to cancer care. This goal facilitated the approval of the project by the oncology committees.

Interdisciplinary stakeholders. The project protocol was ultimately approved by multiple key organizational level committees that served as stakeholders of the practice change: The DCC, The Medical Records Committee, and the oncology staff unit council. Without their approval, the implementation of this project would not have been possible.

Key facilitators of the logistics of the DNP project protocol resulted from the collaboration and productive input provided by interdisciplinary departments including informational technology (IT) department, the oncology pharmacist, and the data analysts. With their support, the BPA was successfully embedded into the EMR and the data was thoroughly collected.

Barriers

Time. A critical barrier to implementation involved the factor of time, as it was essential to respect the schedule of the staff and contributing interdisciplinary groups. It was understandable that this DNP project was an added item to their work volume and therefore, not

always a priority. There were unforeseen sick leave and work vacation taken by critical supporters of the project that negatively affected the proposed timeline.

In addition, because the oncology units were engaging in multiple initiatives in concurrence to the implementation of this DNP project, the nurse managers limited the staff education of the protocol to one, specified week in August. During that week of staff education, the in-service time was constrained by the busy workload of the RN staff. As a result, only 64% of the staff was educated. This limited timeframe in education, as well as the four-month implementation period, was likely insufficient to influence a change in work culture and routine.

Organizational initiatives. In September 2017, the organization underwent a massive upgrade in their EMR, called Triple Play, to align with industry practice. Consequently, in the months that preceded September, all proposed patient safety initiatives that would require builds into the EMR were carefully reviewed and selectively chosen based on urgency and underwent scrutiny to obtain approval by executives. An ultimate hard freeze on all EMR build requests went into effect on July 28, 2017.

Although this DNP project obtained approval by the necessary governing bodies prior to the hard freeze date, the IT group and pharmacist, who were key players in creating the BPA, were understandably occupied with providing Triple Play Command Center support. Therefore, as a result of the time needed to complete successive trial sessions and revisions, the final BPA failed to meet the hard freeze deadline. Ultimately, despite the implementation of the protocol in August through staff education of the algorithm, the BPA was not officially embedded into the EMR until October.

Provider preference. Although the protocol empowered RN staff to recognize GCIH and when to escalate care, the proposal for an RN-driven protocol that would enable autonomy

for the RNs to place BGM, SSI, and Diabetes Team orders was rejected. The oncologists preferred that all orders be obtained and directed through a call. This extra step could have contributed to minimal improvement in outcomes.

Lack of strong evidence. The initial aim of the project was to implement the protocol for all patients with oncologic diagnoses that received glucocorticoids. However, due to the lack of strong supporting evidence for addressing GCIH in the oncology population, as a whole, proposing the protocol to the oncology group was met with slight, but recurrent opposition by select members. Most of the data available focused on patients with hematologic malignancies. As a result, the oncologists approved the project only if it proceeded with the narrow sample group of hematologic malignancy diagnoses. This affected sample size.

Summary

Chapter 4 has featured the last step of the Iowa Model (Titler et al., 2001) with a thorough analysis of the results of the practice change initiative, a comparison of expected and actual outcomes, and facilitators and barriers to the success of the project. Within a four-month implementation period, objectives were not entirely met, however, positive trends were observed, particularly in the increase in number of consults, decrease in uncontrolled hyperglycemia episodes, and reduction in hypoglycemic episodes. To help ensure the project's progression, a prompt recognition of barriers and resilience was essential in developing action plans and pushing forward despite drawbacks.

CHAPTER 5: DISCUSSION

Introduction

With review of the data results in Chapter 4, it is recognized that continuous analysis and modification of the of the practice change should occur to improve processes, as well as project outcomes. Chapter 5 will further examine the results by providing an interpretation of the findings, followed by Table 19 that outlines the implications and recommendations of this project with integration of the eight DNP Essentials. This chapter will conclude with plans for dissemination and sustainment of the practice change.

Interpretation of Findings

Process Evaluation Outcomes

BGM orders. BGM was consistently emphasized as the highest priority of the protocol, as this was the main tool for early detection and served as the paramount precursor to therapeutic interventions for GCIH. The baseline results that spanned April 1st-July 31st, 2017 showed that BGM orders were already being placed 56% of the time, a 9% increase from background data in 2016, as featured in Table 2. In the post-implementation period, there was a 3% increase in BGM orders.

With a minimal increase noted in the implementation period, it is possible that a Hawthorne effect occurred as a result of attendance at multiple oncology committee meetings and oncology staff meetings throughout 2017. During these meetings, presentations from the DNP student and content expert included display of the background data, the proposed practice change, as well as frequent requests for feedback of the DNP project initiatives. These actions likely heightened the awareness of GCIH in the oncology population.

The minimal improvement could also be attributed to the late implementation of the BPA on October 30th, which was midway in the post-implementation period. The initial implementation in August comprised only of an algorithm that relied heavily on the RN being proactive to obtain orders. The BPA provided an alert that subsequently reminded and enabled the providers to conveniently order the BGM. Two months of the BPA may have been insufficient to result in a meaningful change.

SSI orders. SSI orders were concurrently recommended with BGM in efforts to limit the number of resulting uncontrolled hyperglycemia. The post-implementation data showed a 7% decrease in insulin orders. This trend could be attributable to the provider's concern for hypoglycemia, which was frequently mentioned in the oncology meetings. Incidentally, there was a 3% decrease in hypoglycemic episodes in the post-implementation period.

Another reason could be the contrary where the provider may not have been concerned about GCIH in the patient and made the decision to not place insulin orders. However, the number of patients with BGM orders was higher than the number of patients with insulin orders, which means a degree of concern for GCIH must have been present. It would be interesting to explore reasons with the providers for ordering BGM without accompanying treatment.

Diabetes Team consults. Diabetes team consults were encouraged to optimize hyperglycemia management. However, per the protocol, providers and RNs were advised to place consults for patients when BG levels remained consistently greater than 180 mg/dl, despite receiving SSI, in order for the team to assist with BG management. Therefore, although more consults are welcomed, a low number of consults does not necessarily indicate a negative outcome. It could infer that patients are not reaching the >180 mg/dl BG level to meet criteria for consults, which indicates user adherence.

There was an 8% increase in Diabetes Team consults in the post-implementation period. In evaluating the rates of appropriately placed consults per hyperglycemic criteria, there was an improvement as compared to baseline. This improvement was evident by a 54% increase in the number of uncontrolled hyperglycemia episodes with a Diabetes Team consult.

Within this facility, RNs may autonomously place a consult to assist with glycemic management and diabetes education. However, for the purposes of this pilot initiative, the oncologists specifically requested for the RN to call for consult orders. Proposing consistency with the organization for the oncology units in regard to the RN-driven protocol for Diabetes Team consults for further implementation may result in greater improvement in consults.

Impact Evaluation Outcomes

Uncontrolled hyperglycemia episodes. The post-implementation data showed a 3% decrease in total oncology inpatients with BG levels greater than 180 mg/dl. This result could indicate the positive impact of the GCIH protocol on GCIH detection and management, but there is room for improvement. With promotion of early detection and management, a reduction of overall uncontrolled hyperglycemia rates could ensue.

ALOS days. The post-implementation data showed a significant increase in ALOS days for patients with Diabetes Team consults, a decrease in ALOS days for patients without a consult, and an overall ALOS increase of six days. At baseline, there was an 11-day difference in ALOS between the Diabetes Team consult group and those without one, while in the post-implementation data, there was a 50-day difference. This variability emphasizes the challenge in concluding a direct correlation of the presence of a Diabetes Team consult or lack thereof with ALOS.

In both data sets, patients with a Diabetes Team consult experienced longer ALOS days. There are many other contributing factors to prolonged hospitalization, including the admission diagnosis, prognosis, comorbidities, and disposition. Furthermore, the presence of a Diabetes Team consult could equally infer that the patient requires more complex care management, as consults are typically placed by providers for supplementary management. These factors are not accounted for in the scope of this quality improvement project. In the future, it may be advantageous to examine any correlations between uncontrolled hyperglycemia levels and other patient outcomes such as infection/sepsis rates.

Overall, with the resulting sample size of 49, trends can be noted, however the data is not strong enough to produce conclusions. Because it is difficult to predict sustainability solely from initial implementation results, it will be beneficial to conduct sequential evaluations at varying periods throughout the successive implementation processes. Optimally, a growing database will support approval for project expansion.

Implications and Recommendations for DNP Essentials

Doctoral graduates in nursing practice are expected to possess a foundational understanding of the DNP essentials as outlined by the American Association of Colleges of Nursing (2006). Table 21 describes the integration of the eight DNP essential competencies within the development, implementation, and evaluation of this project.

Table 21

Implications and Recommendations for DNP Essentials

DNP Essentials	Implications and Recommendations
Essential I: Scientific Underpinnings for Practice	• Increased awareness of GCIH significance and empowered staff to proactively assess and manage GCIH • Improvement in GCIH detection and management and reduction in the rates of uncontrolled hyperglycemic

	episodes experienced by the inpatient oncologic population receiving GCs
Essential II: Organizational & Systems Leadership for QI & Economics	• Alignment with organizational goals • Gained understanding of the organizational workflow, rigorous practice change approval processes
Essential III: Evidence-Based Practice/Translation Science	• Literature critique and synthesis • Integration of evidence-based knowledge, clinical practice guidelines, and expert opinion from healthcare providers to develop the GCIH protocol • Utilization of the Iowa Model to guide the progression of the project and translate evidence into practice
Essential IV: Information Systems/Technology	• PubMed and CINAHL databases for literature search • Creation of BPA through IT support • EMR used to extract datasets
Essential V: Health Care Policy & Ethics	• Addressed each of the five nursing ethical tenets: 1) Autonomy, 2) Non-maleficence, 3) Beneficence, 4) Justice, and 5) Veracity. • Advocated for oncology patients experiencing GCIH to prevent adverse outcomes
Essential VI: Inter-professional Collaboration	• Collaboration with interdisciplinary departments including IT, Oncology group (DOC, CSC, Oncologists, Pharmacist, staff/managers), Diabetes Group (DCC, Diabetes Team), and data analysts.
Essential VII: Prevention and Population Health	• Development of a standardized process for prompt GCIH recognition and treatment intended to reduce the incidence of uncontrolled GCIH and prevent adverse outcomes that may result from GCIH.
Essential VIII: Advanced Nursing Practice & Education	• Use of evidence-based standards of care, clinical judgement, and collaborative professional relationships to produce and implement GCIH protocol • Increased awareness of GCIH significance and empowered staff to proactively assess and manage GCIH

Plans for Dissemination

The aim of the dissemination plan is to ensure that the stakeholders adequately understand the findings of the evaluation to support further plans for implementation. Securing approval from the key stakeholders to progress towards organizational implementation is the ultimate goal. The DNP student and the content expert will perform dissemination of the findings to the organization.

Dissemination of the evaluation findings to the DCC, the DOC, the Cancer Committee, and the oncology unit staff is projected for March 2018. The presentation of findings will be centered on the impact evaluation results to confirm the degree of the protocol's success. Additionally, the results of the process evaluation will be shared to support the impact evaluation findings. Feedback will be obtained regarding the protocol itself, the process, and any barriers to future implementation plans involving a larger population. Revisions to the protocol and delivery of education for the protocol will be made based on these responses.

Organizational dissemination of results will commence in June 2018 at the Nursing Grand Rounds, which occurs monthly on the third Thursday and features three, hour-long time slots dispersed throughout the day. This forum is open to all staff, however the topics are primarily targeted towards the nursing and advanced practice nursing audiences. Organizational dissemination provides an opportunity to gain larger-scale recruitment of key internal and external stakeholders.

To bring dissemination to a greater audience beyond the organization, another forum for the project is the American Organization of Nurse Executives Conference. This is an ideal opportunity to reach out to other members of the profession statewide and share the findings of the project. Participation in this conference may encourage members of other organizations to

assess the status of GCIH in their own settings and pursue the implementation, which could generate further support for the project. Equally, suggestions for this DNP project may arise based on GCIH protocols that have already been established. Finally, to potentially take dissemination nationwide, submission of a manuscript to an RN and APRN peer-reviewed journal will be done.

Plans for Sustainment

The sustainability of the initiative has the potential to be an equally, if not more challenging, feat than the initial proposal process. New initiatives are continually being introduced; therefore, to promote lasting change, it is essential for the value of the change itself to be internally owned by the stakeholders, rather than externally driven. In order to instill this internal value, direct involvement and active engagement with all types of adopters will be necessary to emanate enthusiasm for the GCIH protocol and foster understanding of the innovation. Continual process evaluations will be conducted, with consideration of all feedback for improvement.

With progression towards organizational implementation, more team members will be recruited to assist with process evaluations and marketing. Marketing the GCIH protocol as a project opportunity for potential clinical ladder RNs will strategically be used. The clinical ladder program is offered at this organization as an opportunity for professional development. This program focuses on the recognition of nurses, who aside from clinical excellence, enhance and enrich the clinical practice environment through involvement in organization activities such as quality improvement projects.

Support from leadership will also be requested to assist with validating the success of the protocol and therefore, serve as motivation for user-adherence. It will be proposed that an

annual review of the impact and process evaluation data be conducted. Subsequently, celebrations can ensue for those units that are effectively utilizing the protocol as evidenced by improvement in rates or continual optimal outcomes. The units will be acknowledged through various incentives approved by the executive team, such as a unit certificate of achievement or cafeteria food vouchers.

Because the BPA had been successfully embedded into the EMR, a degree of change sustainment has been solidified. However, with continual growth of the project, a renewed strategic plan will need to be formulated to effectively recruit a new set of stakeholders of differing adopter types. Specific roles for the stakeholders (e.g., marketing efforts) will be clearly communicated and outlined. Peer accountability to promote user-adherence and advocate for the project will be emphasized as the main responsibility for the stakeholders. Optimally, this peer accountability will help to empower others to do the same.

Summary

In conclusion, this DNP project utilized the seven steps for implementing a quality initiative at a large medical organization, as guided by the Iowa Model by Titler et al. (2001). The intent of this practice change was to immediately initiate BGM and insulin therapy in concurrence with GC orders, thereby aiding in the prompt detection and treatment of GCIH in patients with hematologic malignancies on two inpatient oncology units. It was expected that there would be a resulting reduction in uncontrolled hyperglycemia rates and potentially, ALOS. Employing an evidence-based standardized protocol for the assessment and management of GCIH proved to heighten awareness of GCIH significance and give rise to improvements in uncontrolled hyperglycemia levels. The results helped to reveal promising opportunities for change and progress in the standardized process. However, further benefits for patient outcomes

associated with GCIH management needs to be additionally explored. Concluding with plans for dissemination and sustainability are critical in the ultimate success of this project, which will be signified by organizational implementation for all patients receiving GCs.

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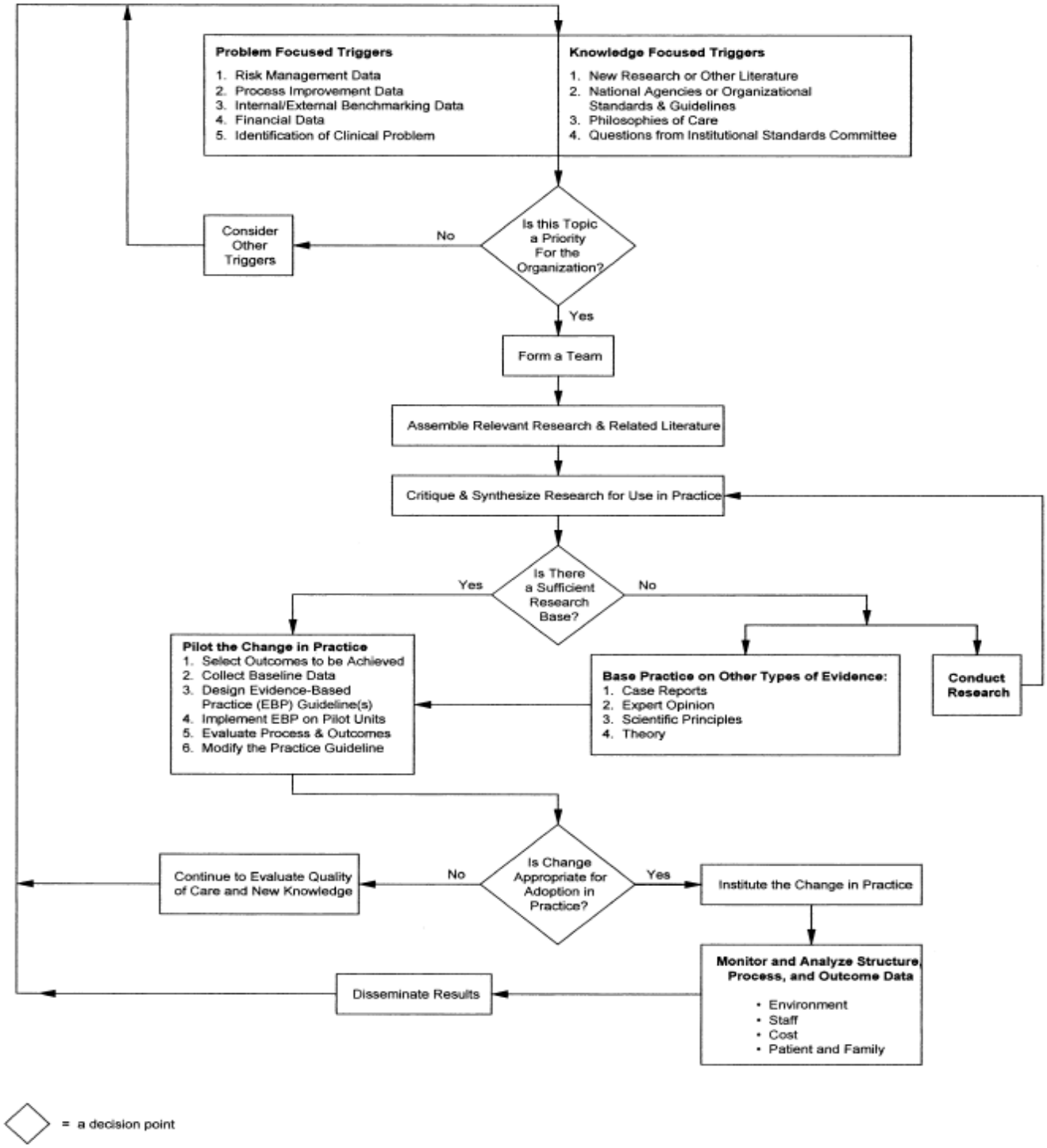
Appendix A

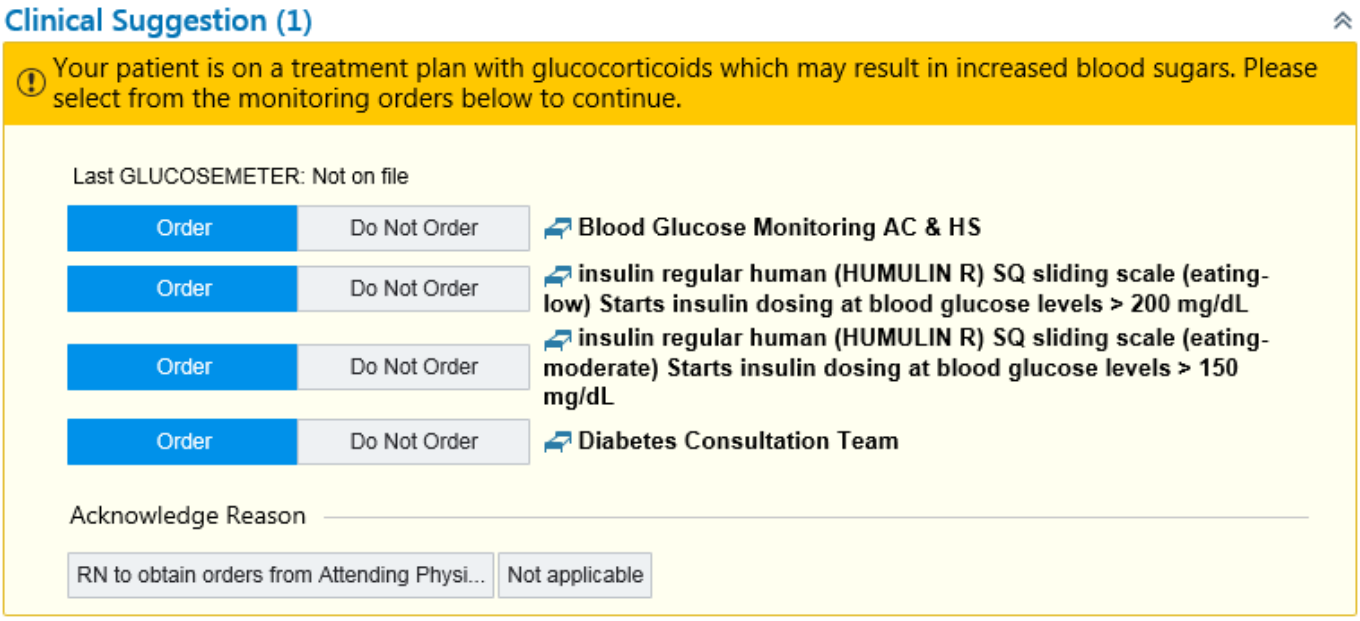
The Iowa Model for Evidence-Based Practice



Adapted from "The Iowa framework of evidence-based practice to promote quality care," by Titler et al., 2001, *Critical Care Nursing Clinics of North America, 13*(4), 497-509.

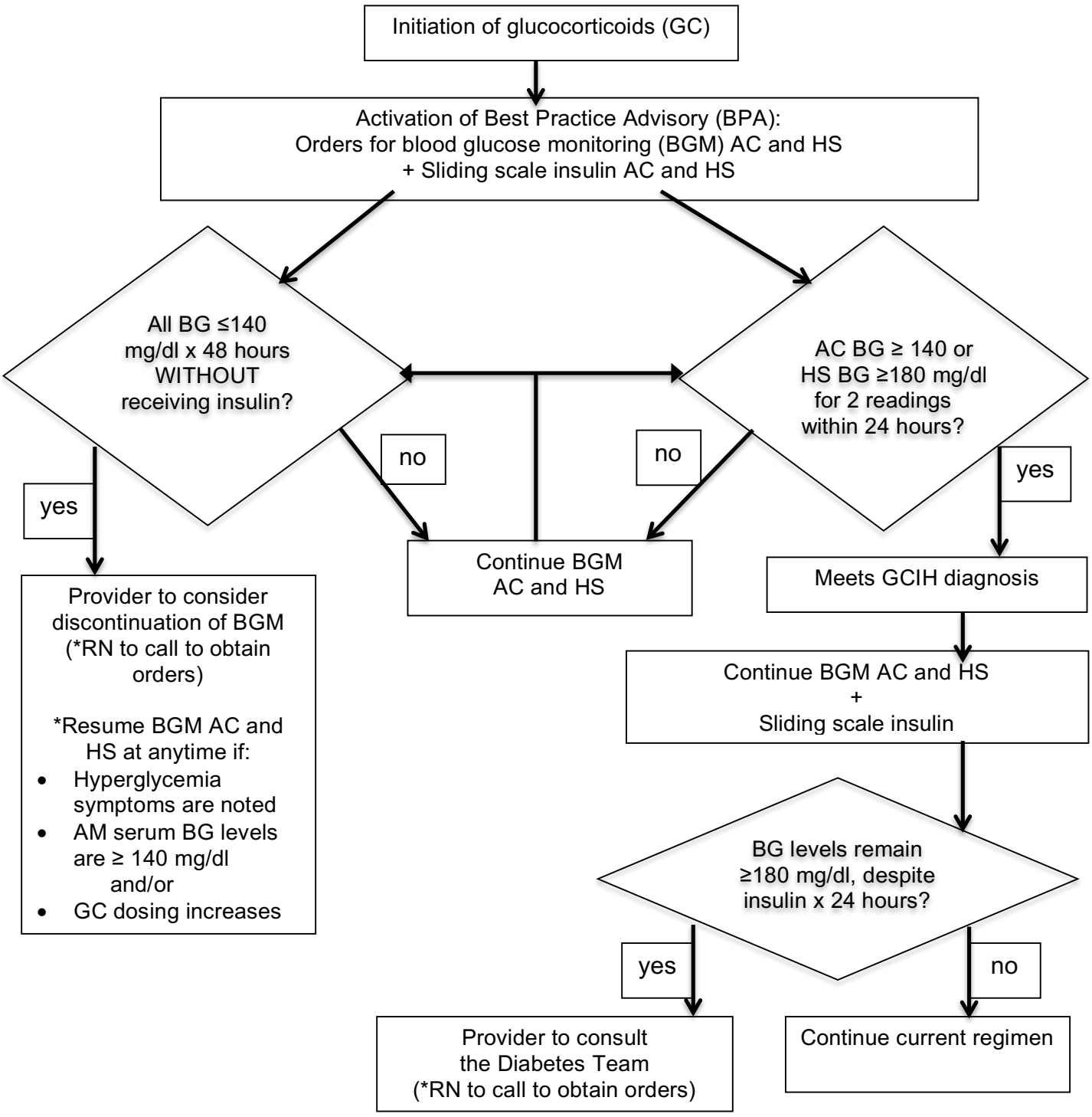
Appendix B

GCIH Best Practice Advisory (BPA)



Appendix C

Assessment and management of inpatient GCIH algorithm



Appendix D

Project logo

Adapted from Popkey. (2017). Emoji. Retrieved from https://popkey.co/featured/emoji-