IMPROVING TIME INTERVALS OF BLOOD GLUCOSE LEVELS AND INSULIN: THE BEST PRACTICE BUNDLE

Doctor of Nursing Practice Project
Presented to the Faculty of Sinclair School of Nursing
Graduate Studies
University of Missouri

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Nursing Practice
by

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Background and Significance

Proper diabetes management for patients in a hospital setting is critical due to their high propensity for co-morbidities such as heart disease, stroke, kidney failure, blindness, and non-traumatic amputations (Kansas Department of Health and Environment, 2019). The 2024 Standards of Care released by the American Diabetes Association (ADA) recommends for hospital patients at mealtime, the delivery of the meal and the insulin administration should be coordinated to prevent hyper and hypoglycemic episodes. Hyperglycemia and hypoglycemia in the hospital setting can lead to an increase in adverse outcomes (ADA, 2023).

Statement of Purpose and PIOT

The purpose of this project is to decrease the time between the point-of-care blood glucose (POC-BG) and insulin administration of patients with hyperglycemia by bundling tasks. This project will improve compliance with the following best practice bundle: The nurse brings into the room together: a glucometer, the patient's tray (if it is mealtime), and a vial of insulin. The patient's POC-BG will be taken, treated immediately, and the patient given their tray, when applicable. The objective of this project is to see at least 75% of insulin administrations ≤15 minutes from the POC-BG in the 2 months post-intervention on two separate units, the Cardiac Care Unit and the Heart and Neurovascular Unit. This will increase compliance with AdventHealth Shawnee Mission's pilot guideline of keeping the time between POCBG and insulin administration ≤15 minutes.

PIOT Question. In hospitalized patients on the Cardiac Care Unit (CCU) and Heart and Neurovascular Unit (HNVU) with hyperglycemia controlled with rapid-acting insulin **(P)**, does adding a best practice bundled process **(I)** decrease the time between the POC-BG and insulin administration **(O)** in the following two months **(T)**?

Literature Review

An extensive review of the literature was conducted about the timing of POC-BG and increasing compliance with a shorter timeframe. Some articles discussed barriers such as high nurse-to-patient ratios, patients not knowing to wait to eat until their blood glucose was checked, poor team member communication, patients being off unit when meals are delivered, a "dining on call system" where patients call for trays at various times, competing priorities of patient care, and convenience POC-BG testing such as during vitals or other rounds rather than specific to mealtime (Dungan, 2019; Kaisen, Parkosewich, & Bonito, 2018). Articles by Engle, Ferguson, & Fields, 2016; Eichmiller, Horner, & Sanjurjo, 2019; Thomas et al., 2022; and Hughes and Caragher, 2021 all discussed the improved glycemic control with a shorter POC-BG to insulin administration interval. They all showed improvement with hypo and hyperglycemia as well as increased nurse satisfaction.

Methodology

Intervention

It was perceived by management that the non-core staff (float pool, flex-staff, agency nurses) were having the most trouble with the pilot. This group was targeted for individual education in the month of December by this researcher. Another intervention was improving communication between the floor staff and the dietary staff over when to pass patient trays and when to hold them. A standardization was decided upon between the managers of the two pilot units and the manager of the dietary staff and communicated through the managers to their staff. There would be a two-sided magnet on patient doors to communicate when the dietary staff would pass the tray or hold the tray.

Other interventions that were performed include modifying and reintroducing an existing bundle, communicating changes in safety huddle each shift, clarifying bundle with staff by rounding on each unit during meals, increasing inventory of insulin vials and glucometers on each unit, reinforcing that the nurse managed bundle should not include the CNA when possible by including education for CNAs as well, identifying consistent noncompliance by individual nurses for follow-up by their managers, and giving gift cards (20 total) randomly chosen from the well-performing staff.

Tools/Measures

Using a confidence interval of 95%, a 5% margin of error, and a population size of 500, a minimum of 109 charts were required for review at each timepoint (Raosoft, n.d.). To ensure an unbiased representation of the sample, 109 charts were randomly selected for review at each timepoint for each unit being evaluated. The primary outcome variable was insulin administrations ≤15 minutes from the POC-BG. Secondary outcome variables were to include pre and post pilot hypo and hyperglycemia rates but was not obtainable from EMR.

Descriptive statistics were utilized to provide an overview of the project sample. Nominal level data was analyzed with the Chi-square Test of Independence, and the *phi* coefficient was used as an index to describe the magnitude of the effect from the intervention with values .10, .30, .50 corresponding with small, medium, and large respectively. Ratio level data was analyzed with the independent *t*-test and Cohen's *d* was used as an index to describe the magnitude of the effect from the intervention with values 0.2, 0.5, 0.8 corresponding with small, moderate, and large respectively. IBM SPSS Statistic version 24 (Chicago, IL) was used for statistical analysis. Statistical significance was defined as $p \leq .05$.

Evaluation

Overall Demographics

There were a total of 446 BG-Insulin intervals measured between the 146 total patient charts reviewed. The CCU had 49 patients during T1 and 39 during T2. The HNVU had 28 patients during T1 and 30 during T2. The predominant age group was 70-79 (34.2%, $n = 50$), followed by 60-69 (24%, $n = 35$), 80-89 (15.1%, $n = 22$), 50-59 (12.3%, $n = 18$), 30-39 (6.2%, $n = 9$), 18-29 (4.1%, $n = 6$), 40-49 (2.7%, $n = 4$), and 90+ (1.4%, $n = 2$). The population was 52.1% male ($n = 76$), with 47.3% female ($n = 69$), and other 0.7% ($n = 1$). The patients' race was majority White (75.3%, $n = 110$), with Black/African Americans at 11.6% ($n = 17$), and other representing 13% ($n = 19$). The majority had insurance under Medicare (68.5%, $n = 100$), private insurance (14.4% $n = 21$), 11% ($n = 16$) with Medicaid, and 6.2% ($n = 9$) with no insurance coverage. There was no statistical significance between groups on age ($p = .19$), gender ($p = .38$), race ($p = .78$), or insurance status ($p = .42$).

For comorbidities, 52.1% ($n = 76$) had a BMI ≥30 with no statistically significant difference between groups ($p = 0.58$). A history of hypertension represented 89% ($n = 130$) with no statistical significance between groups ($p = .58$). A history of stroke or TIA represented 21.9% ($n = 32$) with a statistically significant difference between the HNVU groups from T1 ($p = 8$) to T2 ($n = 14$, $p < .001$). A history of cardiovascular disease represented 67.1% ($n = 98$) with a statistically significant difference ($p = .04$) between the CCU groups from T1 ($n = 37$) to T2 ($n = 29$). Patients with renal impairment represented 64.4% ($n = 94$) with a statistically significant difference ($p = .02$) between the HNVU groups from T1 ($n = 14$) to T2 ($n = 26$).

Primary admitting diagnoses include a cardiac diagnosis (32.9%, $n = 48$), a diabetes-related diagnosis (15.8%, $n = 23$), a neurological diagnosis (13%, $n = 19$), a pulmonary diagnosis (11%, $n = 16$), a diagnosis of sepsis (10.3%, $n = 15$), an orthopedic diagnosis (4.1%, $n = 6$), a

gastrointestinal diagnosis (3.4%, $n = 5$), a diagnosis of weakness or renal-related both had 2.7% ($n = 4$), and other diagnoses count for 4.1% ($n = 6$). There was statistical significance ($p = <.001$) between the two units, with a primary cardiac diagnosis at T1 (HNVU $n = 4$, CCU $n = 21$) and T2 (HNVU $n = 3$, CCU $n = 20$).

POC-BG to Insulin Administration Intervals

Data was collected in November and December 2023 and found CCU had an average of 72.6% BG-Insulin intervals ≤15 minutes ($n = 226$), and HNVU had an average of 34.4% of BG-Insulin intervals ≤15 minutes ($n = 131$). In T1, the CCU had 82.1% of BG-Insulin intervals ≤ 15 minutes ($n = 96$), and in T2, the CCU had 86.2% of BG-Insulin intervals ≤15 minutes ($n = 94$) demonstrating an improvement from pre-intervention average of 72.6%. The mean time between POC-BG and insulin administrations during T1 was 10.4 minutes ($SD = 15.16$) and in T2 was 8.5 minutes ($SD = 8.74$). While not statistically significant, this was a small decrease in mean time between T1 to T2 ($p = .25$, $d = .2$).

In T1, the HNVU had 52.3% of BG-Insulin intervals ≤ 15 minutes ($n = 58$), while in T2, the HNVU had 43.1% of BG-Insulin intervals ≤ 15 minutes ($n = 47$). Despite the decrease in T2, this presented an increase from the baseline of 34.4% of BG-Insulin intervals ≤15 minutes. While not statistically significant, there was a small to moderate increase in the number of > 15-minute intervals with T1 = 47.7% and T2 = 56.69% ($p < .001$, $\varphi = 0.4$). The mean time between the POC-BG and insulin administration during T1 was 23.5 minutes ($SD = 22.08$) and in T2 was 23.1 minutes ($SD = 20.09$). This was not statistically significant ($p = .89$, $\varphi = .02$).

Shift

For the BG-Insulin intervals on CCU that did not meet the goal of ≤ 15 minutes, night shift nurses during T1 were 19% ($n = 4$) and day shift were 81% ($n = 17$). During T2, night shift nurses were 40% ($n = 6$) and day shift were 60% ($n = 9$). For the BG-Insulin intervals on HNVU that did not meet the goal of ≤ 15 minutes, night shift nurses during T1 were 9.4% ($n = 5$) and day shift nurses were 90.6% ($n = 48$). During T2, night shift nurses were 16.1% ($n = 10$) and day shift nurses were 83.9% ($n = 52$). There was a statistically significant decrease in BG-Insulin intervals >15 minutes between the CCU day shift T1 ($n = 17$) and T2 ($n = 9$) ($p = .05$, $\varphi = .05$).

Time of Day

The time-of-day data was collected to evaluate BG-Insulin intervals at breakfast, lunch, dinner, bedtime (HS), and 0200 evaluating the times that were most frequently not meeting the goal of ≤15 minutes. On CCU during T1, 23.8% ($n = 5$) were at breakfast, 23.8% ($n = 5$) were at lunch, 33.3% ($n = 7$) were at dinner, 14.3% ($n = 3$) were at HS and 4.8% ($n = 1$) were at the 0200 time. On CCU during T2, 13.3% ($n = 2$) were at breakfast, 26.7% ($n = 4$) were at lunch, 20% ($n = 3$) were at dinner, 26.7% ($n = 4$) were at bedtime (HS), and 13.3% ($n = 2$) were at the 0200 time. On HNVU during T1, 37.7% ($n = 20$) were at breakfast, 34% ($n = 18$) were at lunch, 18.9% ($n = 10$) were at dinner, 7.5% ($n = 4$) were at bedtime (HS), and 1.9% ($n = 1$) were at the 0200 time. On HNVU during T2, 30.6% ($n = 19$) were at breakfast, 29% ($n = 18$) were at lunch, 27.4% ($n = 17$) were at dinner, 11.3% ($n = 7$) were at bedtime (HS), and 1.6% ($n = 1$) were at the 0200 time. There was a small statistically significant increase at the dinner time on HNVU of BG-Intervals not meeting goal of ≤15 minutes from $n = 10$ to $n = 17$ ($p = .29$, $\varphi = .3$).

Type of Nurse

For CCU in T1, of the 21 nurses who did not perform the BG-Insulin interval within 15 minutes, 47.6% ($n = 10$) were staff nurses, 9.5% ($n = 2$) were Flex staff, 42.9 ($n = 9$) were float pool, and no agency nurses. For T2, 46.7% ($n = 7$), were staff nurses, 13.3% ($n = 2$) were Flex staff, 40% ($n = 6$) were float pool, and no agency nurses. For HNVU in T1, 81.1% ($n = 43$), were

staff nurses, 7.4% (n = 4) were Flex staff, 7.5% (n = 4) were float pool, and 3.8% (n = 2) were agency nurses. For T2, 72.6% (n = 45) were staff nurses, 11.3% (n = 7) were Flex staff, 16.1% (n = 10) were float pool, and no agency nurses. For the nurse type, there was a statistically significant increase in float pool nurses who did not perform the BG-insulin interval within 15 minutes on HNVU from T1 to T2 from n = 4 to n = 10 (p = .01, φ = .01).

Conclusion

The purpose of this project was to evaluate the impact of updating and reintroducing a nurse driven best practice bundle to decrease the time between POC-BG and insulin administrations. The units were chosen for the pilot because the CCU does total patient care and does not utilize nursing assistants, whereas the HNVU does utilize nursing assistants. Secondly, the nurse-to-patient ratio averages 3-4:1 on CCU and 4-5:1 on HNVU. The idea was to use two units with very different workflows to gather information about how different changes are received and implemented as well as how to best spread this pilot to other units.

On the CCU, the average time in November and December for BG-Insulin intervals ≤15 was 72.6%, T1 increased to 82.1%, and T2 increased to 86.2%. The mean time decreased from T1 to T2 by 1.9 minutes. The primary objective was achieved and surpassed, including an increasing percentage of BG-Insulin intervals ≤15 minutes.

On the HNVU, the average in November and December for BG-Insulin intervals ≤15 was 34.4%, T1 increased to 52.3% then decreased in T2 to 43.1%. The mean time decreased from T1 to T2 by 0.4 minutes. There was an overall increase from the pre-intervention total percentage despite the drop in T2. This suggests that although nurses are not hitting the ≤ 15-minute goal as often, they are decreasing the overall time between the POC-BG and insulin administration. The primary objective was not met on HNVU with the BG-Insulin intervals ≤ 15-minutes remaining well under 75%.

Discussion

Shift

The data suggests that on both units, day shift is the most likely to have >15-minute POC-BG to insulin administration times.

Time of Day

On the CCU, during T1, dinner was the most likely time of day to have > 15-minute POC-BG intervals (33.3%) with breakfast and lunch both second at 23.8%. On CCU, T2 had breakfast and dinner both with the highest at 26.7%. On HNVU, during T1, the most likely time to have POC-BG > 15 minutes was breakfast at 37.7% followed by lunch at 34%. On HNVU at T2, the data was spread more even across breakfast at 30.6%, lunch at 29% and dinner at 27.4%.

Type of Nurse.

On the CCU for T1, the nurses most likely to not achieve the ≤ 15-minute BG-Insulin goal were staff nurses (47.6%, n = 10), and float pool nurses (42.9%, n = 9). On the CCU for T2, the nurses most likely to not achieve the goal were staff nurses (46.7%, n = 7) and float pool nurses (40%, n = 6). On the HNVU for T1, the nurses most likely to not achieve the goal were staff nurses (81.1%, n = 43). On the HNVU for T2, the nurses most likely to not achieve goal were staff nurses (72.6%, n = 10). The data suggests that, on the CCU, both staff nurses and float pool nurses were most likely to have POC-BG > 15 minutes. On the HNVU however, the data suggests that the nurses most likely to have POC-BG > 15 minutes were the staff nurses.

Limitations

The hospital had recently changed EMRs to EPIC less than 1 year prior to this project. This made data collection difficult as there were no pre-existing data collection tools for any of

the data required for this project. Each data collection tool was created by this researcher and the stakeholder. This led to difficulty obtaining specific data from pre-intervention as well as more detailed information such as hypo and hyperglycemia rates, which were in the original proposal for this project to evaluate.

Future Research

This pilot project will continue at this site by expanding to other units. In the expansion, the data from this project will help guide the implementation of this bundle by recognizing target areas that are prone to not meeting goals. Research should also continue, when possible, in evaluating the number of hypo and hyperglycemic events in the pre and post pilot periods to measure if the bundle does affect glucose variability.

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Appendix A, D1:

DNP D1 Form

DNP Residential Project Committee Appointment Request

Student's Name: Taylor Coyle

Student's Number: 14325803

Date Submitted: 7/12/23 (updated from 2022 version)

I request that the faculty members listed below be appointed to serve as my Residential Project committee.

Dr. Shawn Zembles	Verbal Consent Received by Taylor Coyle — Digitally signed by Verbal Consent Received by Taylor Coyle Date: 2023.07.18 17:20:44 -05'00'
Name of Chair*	Signature, Chair of Committee
Dr. Carolyn Crumley	Verbal Consent Received by Taylor Coyle — Digitally signed by Verbal Consent Received by Taylor Coyle Date: 2023.07.18 17:21:22 -05'00'
Member*	Signature, Member
Susan Stark	Susan Stark
Member*	Signature, Member
Member*	Signature, Member
Taylor Coyle — Digitally signed by Taylor Coyle Date: 2023.07.12 14:06:57 -05'00'	Miriam D. Butler, DNP, NP-C, FNP-BC — Digitally signed by Miriam D. Butler, DNP, NP-C, FNP-BC Date: 2023.08.21 09:39:46 -05'00'
Signature of Student *Please type or print	Signature of Director of DNP Program, School of Nursing

To be completed during the semester enrolled in:
N9080 Section 1 DNP Residency Project

SON Approved 7/2012
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Appendix B, D3:

DNP D-3 Form

Approval of DNP Residency Project Proposal and the Institutional Review Board Protocol

Candidate's name: Coyle, Taylor (Last Name, First Name) Mizzou ID number: 14325803

Project Title: IMPROVING TIME INTERVALS OF BLOOD GLUCOSE LEVELS AND INSULIN: THE BEST PRACTICE BUNDLE

Signatures of review members
(Please sign full names legibly)

	Acceptable	Unacceptable
Chair: Shawn Zembles Shawn Zembles (print & sign)	☒	☐
Member: (print & sign)	☐	☐
Member: Carolyn E Crumley Carolyn E. Crumley (print & sign)	☒	☐
Member: Susan BStark - MSN, APRN, AGN-BC - NEA-BC (print & sign) Susan BStark	☒	☐
The clinical project is:	☑	☐

The Program Committee has explained the decision regarding the acceptability of my project proposal.

Taylor Coyle
Student Signature

12/6/23
Date

Miriam D. Butler, DNP, NP-C, FNP-BC
Digitally signed by Miriam D. Butler, DNP, NP-C, FNP-BC
Date: 2023.12.07 10:38:25 -06'00'
Director, DNP Program in Nursing

Date