Initiating Early Education for Patients at High-Risk for New Insulin Dependency after Pancreatic Resection

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"On my honor I pledge that I have neither given nor received any unauthorized assistance on this assignment." Christina Kang

Abstract

Purpose: Altered glucose metabolism requiring new insulin dependency in the immediate postoperative period is a known possible complication following pancreatic surgery. The purpose of this quality improvement project is to identify patients with higher risk of new insulin requirement at discharge to initiate education on an earlier postoperative date to optimize self-management knowledge.

Methods: This project utilized a pretest-posttest intervention design to assess insulin self-management knowledge for patients discharged with insulin administration and/or monitoring their glucose at home. Standardized nurse-led education was initiated within 24-48 hours of admission on a surgical-oncology unit for patients identified as "high risk" by a tailored checklist.

Results: Out of 74 patients who underwent a distal pancreatectomy (DP) or pancreaticoduodenectomy (PD) during the implementation period, a total of 11 patients (15%) were identified as high risk per a pre-op risk factor checklist. Three (4%) patients were discharged with insulin and three (4%) were discharged to monitor their glucose levels at home. 78% of patients did not have hemoglobin A1c values prior to their admission. Statistical analysis was not performed due to small sample size.

Implications: This project affirmed the difficulty in identifying patients with new insulin requirement through the evaluation of preoperative risk factors. Notably, serum hemoglobin A1cs are beneficial in identifying patients at increased risk; yet, these values are not regularly drawn in the preoperative setting. During this project period, 8% of patients were either discharged with new insulin requirement or monitoring glucose at home, all of which had self-management education initiated on an earlier postoperative date.

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Introduction

Postoperative impaired glucose tolerance and insulin dependency is a possible negative health outcome following a pancreaticoduodenectomy (PD) or distal pancreatectomy (DP). Yet, the relationship between pancreatic resection and subsequent endocrine dysfunction is understudied. Literature illustrates evidence of various preoperative predictive factors increasing the risk of developing insulin dependency after a PD or DP (De Brujin & van Eijck, 2015; Maxwell et al., 2019). Understanding these characteristics can be used to predict future insulin dependency and thereby influence initiation of patient education at an earlier postoperative date.

Current practices initiate insulin education on a later postoperative day for DP or PD patients on a high-volume surgical-oncology unit at a major academic institution. Education is initiated once patients demonstrate the probable need for insulin beyond the immediate postoperative hospitalization period. The delay in initiating insulin education produces several issues, notably, the missed opportunity to teach and reinforce education early. This brevity can lead to unsafe discharges, potentially increase length of stay, and result in readmission, all relating to complications of inadequate self-management knowledge (Black & Duval, 2019; Corl et al, 2015; Korytkowski et al., 2014).

The purpose of this quality improvement project was to improve glucose self-management knowledge and increase the length of time for inpatient education. Patients at high risk for developing insulin dependency following pancreatic resection were identified using a tailored checklist to facilitate the earlier initiation of insulin knowledge teaching.

Background

While other postoperative complications remain pervasive and methodically scrutinized, new insulin dependency after surgery has been systematically understudied or altogether unaddressed. However, studies demonstrate certain preoperative factors to increase likelihood of insulin dependency after surgery. Understanding these characteristics can be used to predict patient outcomes and thereby influence initiation of patient education.

Unfortunately, patients with impaired glucose control are more likely to be readmitted due to inadequate knowledge of complications, poor self-management skills, and misunderstood changes in treatment regimens (Corl et al., 2015). The American Diabetes Association (ADA) recommends self-management education to begin immediately after inpatient hospitalization to produce favorable health outcomes after discharge (Black & Duval, 2019; Corl et al., 2015). Early consults by a specialized service to manage insulin therapy has corresponded to significantly decrease length of stay (Bansal et al., 2018). Additionally, education provided by staff nurses with support of inpatient diabetes team can effectively reduce the risk of early readmission rates and highlight the importance of hospitalization as a prime opportunity to educate and reinforce content (Corl et al., 2015).

Given this knowledge, identifying patients at higher risk for requiring insulin before discharge would optimize education as outlined by the ADA guideline. This quality improvement project aimed to improve the outcomes of this unique population of postoperative DP and PD patients through utilizing the evidence from the literature to prospectively screen and initiate early education for patients at increased risk for new insulin dependency at discharge, meeting the discharge needs for patients.

Project Aims

1. Examine the rate of patients at high risk for developing new insulin dependency following pancreatic surgery using a tailored checklist developed in IRB00183236.
2. Increase glucose self-management knowledge in patients identified by the checklist through initiating education within 24-48 hours after admission onto surgical-oncology unit.

Review of Literature

The 2019 ADA guideline for standards of care outlines several factors all insulin dependent patients should understand. Patients should be able to demonstrate understanding of identification and treatment of hyperglycemia/hypoglycemia, their specific glucose goals, information on insulin administration, use of home glucometer, and when to call the provider (Black & Duval, 2019). Knowledge on these topics is essential to decrease the risk of readmissions and adverse health outcomes due to poor glycemic control. The guideline suggests that education should be initiated on the day of hospital admission to maximize the time in which a patient receives education and reinforcement.

A distal pancreatectomy (DP), surgical resection of the body and tail of the pancreas, and a pancreaticoduodenectomy (PD), the resection of the head of the pancreas, for non-malignant and malignant causes result in physiological changes that can result in postoperative pancreatic insufficiency and subsequent endocrine dysfunction (Tariq et al., 2019). Notably, alterations in glucose tolerance can thereby increase the risk of worsening diabetes mellitus, new-onset diabetes mellitus (NODM), and/or the development of new insulin dependency (Burkhart et al., 2015; Hirata et al., 2014). Despite this, there is a lack of clear understanding within the literature due to variety of terminology and definitions for new insulin requirement after PD or DP such as

new-onset diabetes, pancreatogenic diabetes, and Type 3A diabetes. Most studies demonstrate an incidence of insulin dependency following a DP or PD ranges widely from 4% to 78% (De Bruijin & van Eijck, 2015; Ferrara et al., 2013; Kwon et al., 2015; Maxwell et al., 2019). The rates of insulin dependency after resection vary greatly, due to the heterogeneity in the length of time for follow-up spanning from 30 days postoperative to several years after surgery (Beger, Poch, Mayer, & Siech, 2018; De Bruijin & van Eijck, 2015). While other reviews follow patients for longer postoperative periods, Ferrera et al. (2013) demonstrated only 4% of patients undergoing PD to develop new-onset diabetes within a 30-day postoperative follow up period.

Certain preoperative characteristics have corresponded to an increased likelihood of endocrine dysfunction following pancreaticoduodenectomy or distal pancreatectomy. Elevated fasting serum glucose levels, elevated hemoglobin A1c, a diagnosis of diabetes or prediabetes, diabetic medication use, older age, and obesity are repeatedly cited to correspond to increased risk of insulin dependency (Beger, Poch, Mayer, & Siech, 2018; Burkhart et al., 2015; De Bruijin & van Eijck, 2015; Hirata et al., 2014; Maxwell et al., 2019; Tariq et al., 2019). Ferrera et al. (2013) found pre-operative glucose intolerance, elevated pre-operative glucose, and specimen length were most predictive of new onset insulin dependency within 30 days after surgery. Maxwell et al. (2019) found that a pre-operative hemoglobin A1c >5.4% independently predicted new-onset diabetes after PD. Per the ADA, patients can be diagnosed with diabetes if hemoglobin A1c $\geq$ 6.5% (American Diabetes Association, 2019).

While the ADA guidelines were developed for all diabetics, and most commonly applicable to Type 2 diabetics, they remain applicable for patients with new insulin dependency following a DP or PD. Developing a checklist of the preoperative factors most cited from

literature to identify and initiate education at an earlier postoperative date complies with the ADA guidelines to improve insulin self-management knowledge.

Translation Framework

The Ottawa Model of Research Use (OMRU), a knowledge translation model is composed of three overarching phases with six key elements, was utilized as the framework guiding project implementation (Appendix A). The first phase of the OMRU is to assess barriers and support, implemented through an interrelated process of understanding evidence-based innovation, characteristics of potential adopters, and the structure and the context of environment (White, Dudley-Brown, & Terhaar, 2016). Understanding unit practices prior to implementation allowed for a comprehensive assessment of support for the project and identify a plan to address varying individual adoption patterns to prevent unforeseen barriers to sustainability. The second phase of the OMRU is to monitor the intervention progress through managing barriers as they arose and following up to adopt as needed (Graham & Logan, 2004). The Plan-Do-Study-Act (PDSA) cycle translation strategy, which guides implementation processes by making rapid small-scale changes in a sequential manner, was particularly useful in this step of the OMRU (Taylor et al., 2014; White, Dudley-Brown, & Tehaar, 2016). PDSA was utilized especially when developing the “high-risk” checklist through feedback and input from varying involved parties. Given the high annual volume of pancreatic surgeries that occur at this hospital, the PDSA cycle to consider sensitivity and specificity based upon a more recent and local population strengthened the validity of this project.

The last phase of the OMRU is to evaluate outcomes through measures of success through staffing acceptance and usage as well as decreasing patient adverse events including decreased insulin knowledge from baseline, increased length of stay and readmissions due to

complications relating to inadequate self-management knowledge. The OMRU allows for the project to refer back to the assessment phase to address arising issues. Additionally, the PDSA cycle, applied within the entire OMRU framework, was particularly necessary during implementation of prospectively screening and initiating early education for patients with feedback and review. Hence, this logical step-wise cyclic approach with careful evaluation and subsequent improvement within a knowledge translation model benefited in the successful implementation and sustainability of this project.

Methods

Project Design and Setting

This quality improvement project utilized a pretest-posttest intervention design to assess insulin self-management knowledge utilizing the Diabetes Knowledge Test (DKT2) 9-item insulin use subscale questionnaire (Bernier et al., 2018; Fitzgerald et al., 2016). The project was conducted on a 36-bed inpatient surgical-oncology unit of a large urban teaching hospital in the mid-Atlantic region of the United States. The unit cares for the majority of postoperative patients following pancreatic resection performed at this hospital.

This quality improvement project obtained approval by the Johns Hopkins Hospital Institutional Review Board (IRB00210139) and from the organization's ethics committee.

Sample

Patients were recruited through convenience sampling during an 11-week implementation period. A total of 74 patients scheduled for a DP or PD were screened. Patients were identified as “high risk” and included for participation if they had three or more of the following characteristics: 1) past medical history of diabetes or pre-diabetes, 2) pre-operative oral diabetic medications, 3) documented hemoglobin A1c >6.5%, 4) point of care glucose >180 mg/dL pre-

operative or within 24 hours after surgery, and 5) over 10 units of insulin administered within 24 hours after surgery. Patients with pre-operative use of insulin were automatically included to participate in the project. Patients not identified by the checklist, however later discharged with new insulin or instructed on home glucometer use, were contacted for inclusion of post-discharge assessment.

Patients were excluded if they had any significant cognitive impairment, admitted after a total pancreatectomy, or hospitalized for readmission. Patients who screened positive on the checklist and did not require new home glucose monitoring or insulin therapy were not assessed post-discharge.

Intervention

Patients scheduled for a DP or PD during the implementation period were assessed at the beginning of the week via Epic chart review for inclusion in the study. If patients met "high-risk" criteria, education was initiated within 24-48 hours upon admission to the surgical-oncology unit. The intervention consisted of standard nursing-led education implemented for a longer duration of the patients' index hospitalization (Black & Duval, 2019). Nursing staff signed off individual topics listed on a blue colored competency checklist attached on the door of participating patients' rooms (Appendix B). DP or PD patients discharged with new insulin dependency, updated insulin regimen, or new home glucometer use were contacted within one week after discharge. The validated DKT2 9-item insulin use subscale questionnaire was administered in-person prior to implementing the intervention and administered via telephone for patients meeting inclusion criteria after discharge (Fitzgerald et al., 2016). Patients with new glucometer use were contacted via telephone for a post-assessment of knowledge on glycemic management amended from the DKT2 9-item insulin use subscale questionnaire. Demographic information

and pre-post DKT2 scores were recorded on an Excel document on a Secure Analytic Framework Environment (SAFE) desktop.

Measures

The high-risk checklist was developed based on literature review, retrospective chart review data, and input from stakeholders. The retrospective chart review of DP and PD patients admitted during the previous calendar year was conducted prior to the project implementation period. While the chart review demonstrated the heterogeneity of factors influencing immediate postoperative insulin dependency, it also revealed increased risk if on previously on diabetic medication and hemoglobin A1c values over 6.5%.

There were two main measurement components in this quality improvement (QI) project. The checklist prospectively determined the proportion of patients considered high risk requiring insulin at discharge among all patients after a DP or PD during the intervention period. Second, changes in pre- and post-intervention knowledge scores for these patients were obtained from validated Diabetes Knowledge Test (DKT2) 9-item insulin use subscale questionnaire (see Appendix C). The DKT2 is a quick and low-cost valid instrument that can reliably assess general knowledge of diabetes and self-care (Fitzgerald et al., 2016). The insulin subscale questionnaire is composed of nine multiple choice questions to assess knowledge on insulin management. Only four questions on the DKT2 9-item insulin use subscale questionnaire pertained to knowledge of glycemic management; therefore, only these questions were administered for patients discharged newly monitoring their glucose at home. Patient demographic information was collected through chart review.

Procedures

All nursing staff on the surgical-oncology unit are trained during their orientation period to deliver standardized insulin/diabetes education for pancreatectomy patients. Hence, for this QI project, we did not identify nursing knowledge gap as the problem. The project was introduced to all staff through huddle announcements, email communication, and team meetings. The high-risk checklist was developed based on literature review, retrospective chart review data collected from IRB00183236, and input from stakeholders.

During the 11-week implementation period, all patients scheduled for a DP or PD were screened for inclusion. Patients with over three risk factors on the high-risk checklist were identified and monitored for the date of admission to the surgical-oncology unit. Within 24-48 hours upon admission, the DKT2 9-item insulin use subscale questionnaire was administered in-person and the nursing staff were alerted to initiate and integrate education throughout the patient's hospitalization. Participating patients were identifiable by a blue colored competency checklist attached on the doors (Appendix B).

Patients discharged from their index hospitalization with new insulin requirement or new home glucose monitoring were contacted over telephone within one week for post-assessment. DP or PD patients discharged with new insulin dependency or glucometer use but not captured by the checklist were contacted within one week for a post-discharge assessment of knowledge. Two attempts on separate occasions were made for contact. All demographic information and pre-post DKT2 scores were recorded on an Excel document in SAFE desktop. Data analyses was concluded by May 2020.

Analytic Plan

The outcome of the first aim was to determine the proportion of patients identified prospectively during a 11-week intervention period as "high risk" according to the checklist

among all DP or PD patients. This determined the accuracy of the checklist by providing a ratio of patients discharged with new insulin or required to newly monitor blood glucose at home over those who screened positive on the "high risk" checklist.

Data obtained from chart review included procedure type, age, sex, race, BMI, pre-operative diagnoses of diabetes, hemoglobin A1c, serum glucose level, length of initial stay, start date of education, and length of education. Wilcoxon signed-rank test was originally planned to analyze the second aim. However, given the limitations of a small sample size, the second aim was evaluated with descriptive statistics.

Results

A total of 74 patients underwent a DP or PD during the 11-week implementation period, 24 (32%) underwent DP and 50 (68%) underwent PD. Seven patients (10%) were initially identified as "high risk" according to the checklist. Three additional patients were considered "high risk" once hemoglobin A1c values were collected during their inpatient stay. A total of eleven patients (15%) were assessed for pre- and/or post-intervention.

The median age of the included patients was 68 years (IQR 9.3). Four patients underwent a DP and seven had a PD. The median length of stay was nine days (IQR 9), with a median six days of education (IQR 4).

Table 1. Baseline characteristics of participants

Demographic characteristics	***(N = 11)***
Age, median (IQR)	68 (9.3)
Sex, n (%)	
Male	3 (27)
Female	8 (74)
Procedure, n (%)	
Distal pancreatectomy	4 (36)
Pancreaticoduodenectomy	7 (64)
Length of stay, median (IQR)	9 (9)
Length of education, median (IQR)	6 (4)

IQR = interquartile range

Patients were considered “high risk” if they had three or more of the characteristics listed in the “high risk” checklist, highlighted in Table 2. The median DKT2 9-item insulin use subscale questionnaire score of nine patients before education was 5 (IQR: 1). Two patients, requiring new glucometer education before discharge, were not captured for the pre-intervention score as they did not meet high risk inclusion criteria on the checklist.

Table 2. Characteristics included in high-risk checklist items

Characteristic	Patients with new post-op insulin (N = 3)	Patients with new glucometer (N = 3)
Pre-op diagnosis of Diabetes, frequency	3	2
Pre-op Hemoglobin A1c, median	8	6.8
Pre-op DM medications, frequency	1	0
Pre-op insulin use, frequency	1	0
24-hr max POCT glucose post-op, median	334	191
24-hr insulin administration, median	10	9
Total score, median	4	2

Pre-op = preoperative

Three patients were discharged with new post-operative insulin and three patients were discharged with glucometer education during the project period. A total of four patients were evaluated after discharge. Two patients with new insulin had a 1-point improvement between their pre- and post-education DKT2 scores. One patient was lost to follow up. Two patients with glucometer education had post-discharge assessment, scoring three out of four applicable questions correct (Table 3).

Table 3. Characteristics of patients discharged with post-op insulin or new glucometer use

	Patients with new post-op insulin (N = 3)	Patients with new glucometer (N = 3)
Checklist score, median	4	2

Procedure type		
Distal pancreatectomy	2	1
Pancreaticoduodenectomy	1	2
Length of stay, median	16	9
Length of education, median	8	7
DKT2 score		
Pre-education score, median	6	5
Post-education score, median	7.5	3

DKT2 = Diabetes Knowledge Test 9-item insulin use subscale questionnaire

Discussion

A retrospective chart review performed as a separate study of the previous calendar year at the same high-volume academic facility identified 6% of DP or PD patients were discharged with new insulin following their index hospitalization. This rate was closely aligned to a study by Ferrera et al. (2013) identifying 4% of patients had developed diabetes within 30-days following pancreatectomy. Multiple risk factors were evaluated through the retrospective chart review and literature to develop the high-risk checklist utilized in this project. Previous diabetic medication uses or hemoglobin A1c values > 6.5% were two risk factors correlating to the development of insulin dependency following pancreatic surgery (Beger, Poch, Mayer, & Siech, 2018; De Brujin & van Eijck, 2015; Tariq et al., 2019). Immediate postoperative glucose values and insulin requirement 24 hours after surgery were included in the high-risk checklist as they were identified by providers to correspond to new insulin requirement after pancreatectomy.

The high-risk checklist utilized in this project was able to identify all patients who eventually were discharged with new insulin requirement following a DP or PD. The inclusion criteria for project participation was widened to include patients discharged to monitor their blood sugars at home occurred during the implementation period as they had been identified through the checklist and education was initiated early. Two distal pancreatectomy (DP) patients

(8%) and one pancreaticoduodenectomy (PD) patient (2%) were discharged with new insulin use during the study period. However, 15% (11) of all DP or PD patients were flagged as "high risk," meeting parameters to initiate early education. Of the identified patients, one DP patient (4%) and two PD patients (4%) were discharged with inpatient education on monitoring glucose levels at home.

Discharges with new insulin requirement or close glucose monitoring at home are more complex, requiring competence in multiple aspects of managing care from understanding pathophysiology to action plans for hypoglycemia or hyperglycemia. Development of a sensitive checklist allow nursing staff to initiate a structured diabetes self-management upon admission, thereby optimizing patient outcomes by increased opportunity for education (Black et al., 2019). By identifying higher risk patients at an earlier postoperative date, nursing staff was able to deliver education and reinforce knowledge at multiple time points throughout the patients' hospitalization.

One of the most profound limitation to this project was the small sample size. Only two pre- and post-DKT2 scores were fully evaluated. There was a limited sample size of patients discharged with new insulin (n = 3), with one of these patients lost to follow up. Only two pre-/post-education assessments were evaluated. Additionally, two patients discharged with new glucose monitoring were evaluated for post-education assessment as they were not initially identified and included in the "high risk" inclusion criteria. However, only four of the nine questions were valid for evaluation. The low sample size was similar to the number of patients identified in retrospective analyses of patients with new insulin dependency after pancreatectomies at this institution and literature review.

One of the easiest methods in identifying patients at risk of new insulin dependency following DP or PD is having a hemoglobin A1c value prior to surgery. Several studies have demonstrated a correlation between insulin dependency and elevated A1c values (Hirata et al., 2014; Maxwell et a., 2019). Despite the correlation, A1c values are not routinely drawn in the preoperative setting due to greater systemic barriers such as insurance. While 74 patients underwent a DP or PD during the implementation period, 58 patients (78%) did not have hemoglobin A1c values within the last three months prior to admission. This value can be added as a standard in the preoperative evaluation process preceding surgery or may be integrated into Epic to be drawn on the initial postoperative day. Three patients had hemoglobin A1cs drawn during their hospitalization, two of which demonstrated values >6.5% and eventually discharged with new insulin or glucose monitoring. However, education was not initiated on an early postoperative date as they did not initially meet high risk criteria. Despite the limitations presented in this project, the findings can aid the future directions in practice by guiding clinicians to identify specific patients to better prepare them for discharge following a DP or PD.

Conclusion

The inability to accurately identify patients requiring immediate insulin administration following distal pancreatectomy (DP) or pancreaticoduodenectomy (PD) in the preoperative setting limits the adherence to initiate early education according to the ADA guidelines. The novel high-risk checklist flagged 15% of all patients admitted to a high volume surgical-oncology unit following DP or PD. During an 11-week implementation period, only 4% of patients were discharged with new insulin requirement and 4% of patients were discharged monitoring their glucose at home. 54% of the identified patients were discharged with new requirements to monitor their blood sugar at home and/or administer insulin, thereby benefiting

from early education. This project outlined the benefit of obtaining a hemoglobin A1c value in the pre-operative setting as a correlate indicator for increased risk of immediate postoperative insulin requirement before discharge. While 74 patients underwent a DP or PD during the implementation period, 58 patients (78%) did not have hemoglobin A1c values prior to their admission. Best practices to implement the collection of this value on admission to the unit through integration on the current Epic pathway order sets remains an ongoing discussion with advanced practice providers.

Dissemination

The results and findings from this project will be presented to the unit staff and advanced practice providers to contribute to the ongoing care practices to improve patient outcomes. Additionally, the outcome of this project will be integrated into a manuscript for a peer-reviewed journal pending from the results of the separate retrospective chart review project. The project will be presented during the DNP project symposium in May 2020.

Sustainability Plans

The project demonstrates great potential for sustainability with ongoing development and planning. By increasing knowledge and obtaining appropriate laboratory values, all members of the healthcare team can advocate for initiation of education on an earlier postoperative date. The “high risk” checklist will be available for staff to use as a resource. Given that all resources and focus has been shifted towards addressing the current global Covid19 pandemic, further dissemination and sustainability aspects will be ongoing for a later date.

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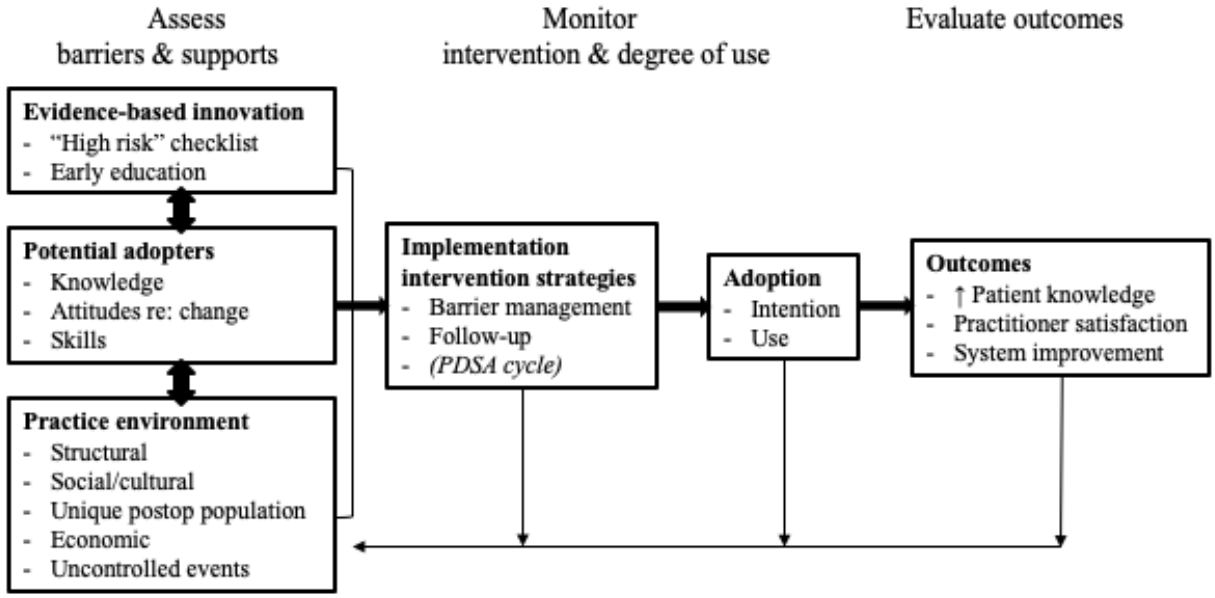
Appendix A

Ottawa Model of Research Use (OMRU) Translational framework as it applies to this quality improvement project (Graham & Logan, 2004; White, Dudley-Brown, & Terhaar, 2016)



Appendix B

Teach-form checklist to be attached on doors of patients identified as "high risk." Form is amended from existing unit teach-form sheet.

Date/Initials/Title		Teach Needs - Place on outside of patient's room door
Teaching done	Patient competent	
		Given Diabetes education folder with handouts/booklets • Stored in labeled cabinet on 4C & 4D
		Assigned and Watched videos on Bedside MyChart • Counting Carbs, Checking Blood Glucose, Injecting Insulin
		Define diabetes and why we check blood glucose
		Review when and how to test blood glucose • Before 3 main meals and HS, demonstrate how to check
		Discuss signs and symptoms of hypo- and hyperglycemia and management of each • Advise patients to carry glucose tablets or hard candy with them

		Review goal blood glucose ranges
		• Target blood sugars: 100-180 before meals and at bedtime
		• Call your doctor for:
		  • ANY blood sugars below 70
		  • ANY blood sugars above 300
		  • 4 blood sugars in a row above 200

		Discuss types of insulin • Long-acting: *Insulin glargine (LANTUS, TOUJEO, BASAGLAR), Insulin detemir (LEVEMIR), Insulin degludec (TRESIBA)* • Short-acting, also called nutritional, correctional: *insulin aspart (NOVOLOG), insulin glulisine (APIDRA), insulin lispro (HUMALOG)*
		Discuss preparation/administration/storage of insulin

Appendix C

Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test (DKT2)
9-item insulin use subscale (Fitzgerald, Funnell, Anderson, Nwankwo, Stansfield & Piatt, 2016)

1	Signs of ketoacidosis (DKA) include: a) Shakiness b) Sweating c) Vomiting d) Low blood glucose
2	If you are sick with the flu, you should: a) Take less insulin b) Drink less liquids c) Eat more proteins d) Test blood glucose more often
3	If you have taken rapid-acting insulin, you are most likely to have a low blood glucose reaction in: a) Less than 2 hours b) 3-5 hours c) 6-12 hours d) More than 13 hours
4	You realize just before lunch that you forgot to take your insulin at breakfast. What should you do now? a) Skip lunch to lower your blood glucose b) Take the insulin that you usually take at breakfast c) Take twice as much insulin as you usually take at breakfast d) Check your blood glucose level to decide how much insulin to take
5	If you are beginning to have a low blood glucose reaction, you should: a) Exercise b) Lie down and rest c) Drink some juice d) Take rapid-acting insulin
6	A low blood glucose reaction may be caused by: a) Too much insulin b) Too little insulin c) Too much food d) Too little exercise
7	If you take your morning insulin but skip breakfast, your blood glucose level will usually: a) Increase b) Decrease c) Remain the same
8	High blood glucose may be caused by: a) Not enough insulin b) Skipping meals c) Delaying your snack d) Skipping your exercise
9	A low blood glucose reaction may be caused by: a) Heavy exercise b) Infection c) Overeating d) Not taking your insulin

Comment Summary

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1. Usually we describe the measures with a little more detail in the methods section
2. great. Make sure results are not newly presented in this last section.